



The Effects of Home Visiting on Prenatal Health, Birth Outcomes, and Health Care Use in the First Year of Life

Final Implementation and Impact Findings from the
Mother and Infant Home Visiting Program Evaluation-Strong Start

OPRE Report 2019-08
January 2019

The Effects of Home Visiting on Prenatal Health, Birth Outcomes, and Health Care Use in the First Year of Life: Final Implementation and Impact Findings from the Mother and Infant Home Visiting Program Evaluation-Strong Start

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Contract Number: HHSP23320095644WC

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Suggested citation: Lee, Helen, Sarah Shea Crowne, Melanie Estarziau, Keith Kranker, Charles Michalopoulos, Anne Warren, Tod Mijanovich, Jill H. Filene, Anne Duggan, and Virginia Knox. (2019). *The Effects of Home Visiting on Prenatal Health, Birth Outcomes, and Health Care Use in the First Year of Life: Final Implementation and Impact Findings from the Mother and Infant Home Visiting Program Evaluation-Strong Start*. OPRE Report 2019-08. Washington, DC: Office of Planning, Research, and Evaluation, Administration for Children and Families, U.S. Department of Health and Human Services.

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The work in this publication was performed under Contract No. HHSP23320095644WC awarded by the U.S. Department of Health and Human Services (HHS) to contractor MDRC and subcontractors James Bell Associates, Johns Hopkins University, Mathematica Policy Research, and New York University.

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Dissemination of MDRC publications is supported by the following funders that help finance MDRC's public policy outreach and expanding efforts to communicate the results and implications of our work to policymakers, practitioners, and others: The Annie E. Casey Foundation, Charles and Lynn Schusterman Family Foundation, The Edna McConnell Clark Foundation, Ford Foundation, The George Gund Foundation, Daniel and Corinne Goldman, The Harry and Jeanette Weinberg Foundation, Inc., The JPB Foundation, The Joyce Foundation, The Kresge Foundation, Laura and John Arnold Foundation, Sandler Foundation, and The Starr Foundation.

In addition, earnings from the MDRC Endowment help sustain our dissemination efforts. Contributors to the MDRC Endowment include Alcoa Foundation, The Ambrose Monell Foundation, Anheuser-Busch Foundation, Bristol-Myers Squibb Foundation, Charles Stewart Mott Foundation, Ford Foundation, The George Gund Foundation, The Grable Foundation, The Lizabeth and Frank Newman Charitable Foundation, The New York Times Company Foundation, Jan Nicholson, Paul H. O'Neill Charitable Foundation, John S. Reed, Sandler Foundation, and The Stupski Family Fund, as well as other individual contributors.

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Overview

Improving birth outcomes among socioeconomically disadvantaged women has been a long-standing policy goal. One potential approach to improving birth outcomes is home visiting, which provides pregnant women and families who have young children with education and support, assessment, and referrals to community services. A few prior studies of evidence-based home visiting models — specifically, Healthy Families America (HFA) and Nurse-Family Partnership (NFP) — revealed some improvements in low birth weight and preterm birth. However, these results have not been found in all prior studies of the models' examinations of birth outcomes and were conducted years ago, from the late 1970s through the early 2000s. Given that both families and local programs have changed since those studies were completed, a new test of whether home visiting programs can improve birth outcomes was warranted.

The Mother and Infant Home Visiting Program Evaluation-Strong Start (MIHOPE-Strong Start) was launched in 2012 to test whether evidence-based home visiting provided during pregnancy improves birth outcomes, prenatal health, and health care use in infancy. Specifically, the MIHOPE-Strong Start analysis includes 2,900 families across 66 local HFA and NFP home visiting programs in 17 states. The Administration for Children and Families partnered with the Centers for Medicare and Medicaid Services and the Health Resources and Services Administration to sponsor MIHOPE-Strong Start. MDRC conducted the evaluation in collaboration with James Bell Associates, Johns Hopkins University, Mathematica Policy Research, and New York University. This report presents final implementation and impact results from the study. A separately published report from the Mother and Infant Home Visiting Program Evaluation (MIHOPE) presents program effects on a wider range of family outcomes and for two additional evidence-based models.

Primary Research Questions

1. What services do families receive from home visiting programs to promote prenatal health and improve birth outcomes?
2. What are the effects of evidence-based early childhood home visiting on prenatal care, birth outcomes, and infant health care use?
3. How do the effects of home visiting programs vary across different types of families, based on the features of local programs, and according to the dosage of home visiting services families receive?

Key Findings and Highlights

- **Families who received at least one home visit had an average of eight visits over four months before the woman gave birth.** Families received a similar amount of home visiting as found in prior studies, including those that found reductions in the percentage of infants born preterm or with low birth weights.

- **Women who were more and less vulnerable to poor birth outcomes received similar levels of home visiting services.** Among women who received at least one home visit, those who exhibited risks for compromised birth outcomes (such as being of a younger age or being a smoker) received the same number of visits and participated for similar lengths of time, on average, as women who didn't demonstrate such risks.
- **The home visiting programs in the study had no statistically significant effect on the evaluation's focal outcomes, including families' prenatal behaviors, birth outcomes, or health care use in the first year after birth.** The estimated differences found in the study's main outcomes, such as low birth weight and preterm birth, are small, and they are not statistically significant.
- **Effects of the home visiting programs in the study are not greater for higher-risk or for lower-risk families or depending on how the programs were implemented.** Home visiting did not have larger effects on prenatal behaviors, birth outcomes, or health care use after birth for any subgroups of families, nor do the effects vary across local programs or by evidence-based model.

One reason that the effects of home visiting in this study are small might be that there was little room for improvement on modifiable risk factors such as smoking, nutritional support, and access to prenatal health care. For example, only a small percentage of women smoked during pregnancy and most had access to health care providers during and after pregnancy. Another possible reason is that families did not receive as many home visits as the evidence-based models had intended, although they participated at levels similar to those found in prior HFA and NFP evaluations of birth outcomes. In addition, the findings are specific to the primarily urban sample of local programs and families, who would have had greater access to alternative prenatal health care services, and may not be generalizable to home visiting in areas where access to prenatal health care might be more limited.

It is important to remember that at the time of MIHOPE-Strong Start's launch, previous studies of the evidence-based models' effectiveness at improving birth outcomes were inconsistent or relevant only to subgroups of families. In addition, these studies' analyses of birth outcomes were completed between 15 and 40 years ago, and the characteristics of families who are eligible for home visiting have changed; for example, the prevalence of smoking is lower and home visiting programs have evolved, raising the question of whether the next generation of programs is more likely to have effects on birth outcomes. MIHOPE-Strong Start provides new evidence that home visiting, as implemented by the local programs in this study, did not have a substantial effect on improving birth outcomes for the first birth after women enrolled in the program. Research on the epidemiology of newborn health suggests that it is challenging for any single intervention to improve birth outcomes, given the cumulative effects of stress that women with low

incomes often experience.¹ Whether home visiting programs may have longer-term impacts, including positively affecting birth outcomes for later pregnancies, is a question for future research. Furthermore, as local programs in this study were recruited from 2012 to 2015, it is possible that they have continued to evolve over the past few years in ways that could make them effective at improving birth outcomes.

Methods

MIHOPE-Strong Start included home visiting programs that implemented either HFA or NFP, two widely used models and the only ones with some prior evidence of having effects on improving birth outcomes at the time programs were recruited into the study. Sixty-six local programs that primarily served Medicaid beneficiaries contributed to the MIHOPE-Strong Start analysis. Local programs did not have to be receiving MIECHV funding to participate in the study. A total of 2,900 women who were no more than 32 weeks pregnant and were eligible and interested in receiving home visiting were included in the analysis. Families were randomly assigned either to a local home visiting group or to a control group whose members were given information on other appropriate services in the community. The random assignment design was intended to create program and control groups that were similar when they entered the study, so that systematic differences between the two groups in the outcomes of interest could be attributed to the home visiting services rather than to the preexisting characteristics of the women. Although 14 percent of the program group sample received no home visiting, all program group families were included in the analysis even if they did not receive any services, as is standard practice in studies that use random assignment. This was done to maintain the comparability between program and control groups generated by random assignment.

Information on program implementation comes from family surveys at baseline, descriptions home visitors provided about the services they delivered to families, surveys of home visitors and local program managers, interviews and surveys with evidence-based model developers, and management information system data. For the impact analysis, family outcomes were obtained from state vital records and Medicaid data.

¹Michael S. Kramer, Louise Seguin, John Lydon, and Lise Goulet, "Socio-Economic Disparities in Pregnancy Outcome: Why Do the Poor Fare So Poorly?" *Paediatric and Perinatal Epidemiology* 14, 3 (2000): 194-210.

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Acknowledgments

The ability of the Mother and Infant Home Visiting Program Evaluation-Strong Start (MIHOPE-Strong Start) to develop a greater understanding of how evidence-based home visiting affects prenatal health, birth outcomes, and health care use in the first year of life comes from the states and local programs that participated in MIHOPE-Strong Start. We are deeply grateful for their involvement as well as for that of the families who contributed to the study. We also thank the project's recruitment team, which was led by Sharon Rowser and Dina Israel at MDRC and had team members from MDRC (Rebecca Behrmann, Marie Cole, Rachel Dash, Katie Egan, Suzanne Finkel, Caroline Mage, Colleen McCullough, Alexandra Parma, Ada Tso, Alexander Vasquez, Ashley Weech, and Evan Weissman); James Bell Associates (Patrice Cachat, Nicole Miller, Kerry Ryan, Lance Till, and Susan Zaid); Johns Hopkins University (Kristen Ojo); and Mathematica Policy Research (Charlotte Cabili, Jacob Hartog, Luke Heinkel, Jessica Jacobson, and Cheri Vogel), as well as contractors Courtney Harrison and Mike Sack. In addition, this effort would not have been possible without the assistance of Healthy Families America (HFA) and Nurse-Family Partnership (NFP) model staff members at the national and state levels as well as project officers from the Health Resources and Service Administration (HRSA) and administrators of the Maternal, Infant, and Early Childhood Home Visiting (MIECHV) program, whom the team consulted in various states.

At the Office of Planning, Research, and Evaluation (OPRE) of the Administration for Children and Families (ACF), Lauren Supplee helped launch MIHOPE-Strong Start and guide it during its early years, while Nancy Geyelin Margie and Laura Nerenberg have provided regular feedback to the study team more recently. This final report for MIHOPE-Strong Start reflects suggestions from Naomi Goldstein, Nancy Geyelin Margie, Laura Nerenberg, Emily Schmitt, and Maria Woolverton from OPRE; Caitlin Cross-Barnet, Susan Jackson, Donelle McKenna, and Erin Patton from the Center for Medicare and Medicaid Innovation of the Centers for Medicare and Medicaid Services (CMS); and Meseret Bezuneh, Rachel Herzfeldt-Kamprath, Laura Kavanagh, Judy Labiner-Wolfe, Kyle Peplinski, Cynthia Philips, and David Willis from the Maternal and Child Health Bureau of HRSA.

The discussion of the evidence-based home visiting service plans of HFA and NFP was greatly informed by available program documentation and through surveys and exchanges with the evidence-based model developers, including Kathleen Strader and Kathryn Harding at HFA and Felicia Fognani, Molly O'Fallon, and Kate Siegrist at NFP.

Medicaid and vital records agencies in the 17 states that participated in MIHOPE-Strong Start supplied the data used to analyze outcomes in this report. Sources include the Health Information and Research Section at the California Department of Public Health; the California Health and Human Services Agency's Department of Health Care Services; the Georgia Department of Community Health; the Georgia Department of Public Health; the Illinois Department of Healthcare and Family Services; the Illinois Department of Public Health, Division of Vital Records; the Indiana Family and Social Services Administration; the Iowa Department of Human Services; the Iowa Department of Public Health; the Kansas Department of Health and Environment, Bureau of Epidemiology and Public Health Informatics, Office of Vital Statistics; the Kansas Department of Health and Environment, Division of Health Care Finance; the Massachusetts Department of Public Health, Registry of Vital Records and Statistics; the Massachusetts Executive Office of Health and Human Services; the Michigan Department of Health and Human Services, Bureau of Epidemiology and Population Health/Early Childhood Health Section; the Nevada Department of Health and Human Services, Division of Health Care Financing and Policy; the Nevada Department of Health and Human Services, Division of Public and Behavioral Health; the New Jersey Department of Health, Center for Health Statistics; the New Jersey Department of Human Services, Division of Medical Assistance and Health Services; the New York State Department of Health, Office of Health Insurance Programs and Bureau of Production Systems Management, Vital Records; the Bureau of Vital Statistics at the New York City Department of Health and Mental Hygiene; the North Carolina Department of Health and Human Services, State Center for Health Statistics, as well as the State Division of Medical Assistance; the Pennsylvania Department of Health, Bureau of Health Statistics and Research in Harrisburg; the Pennsylvania Department of Public Welfare, Office of Medical Assistance Programs; the South Carolina Department of Health and Environmental Control; the South Carolina Office of Research Statistics; the Tennessee Department of Health; the Tennessee Department of Finance Administration, Division of Health Care Finance and Administration; the Washington Office of Medicaid Systems; the Washington Health Care Authority Department; the Wisconsin Department of Health Services, Division of Public Health, Office of Health Informatics; and the Wisconsin Department of Health Services, Division of Enterprise Services.

We would like to acknowledge the many contributions of the MIHOPE-Strong Start data team in acquiring and processing administrative data as well as in checking and analyzing information provided by the programs and families. In particular, at MDRC, Desiree Alderson oversaw the data work for MIHOPE. Electra Small developed the web surveys used with home visiting program staff members with assistance from Melinda Jackson and Alexandra Parma. Noemi Altman led the efforts in administrative

data acquisition and processing. Lori Burrell from Johns Hopkins University expertly managed home visitors' baseline survey data. Additionally, MIHOPE-Strong Start was able to use a multiplicity of data sources, thanks to the contributions of many staff members from various organizations who acquired, checked, and analyzed these data: MDRC (Patricia Chou, Eric Cohn, Kristen Faucetta, Hiwote Getaneh, Lakhpreet Gill, Jessica Kopsic, Lyndsay McDonough, Megan Millenky, Robert Mitchell, Katie Rue, Kelly Saunders, Jennifer Somers, Kelly Terlizzi, and Samantha Xia); James Bell Associates (Alexandra Joraanstad, Erin Morehouse, Yuan Wang, and Ziyun Wang); Johns Hopkins University (Alexandra Cirillo Lilli and Michele Trieb); and Mathematica Policy Research (Liz Clary, Brittany English, Jaimie Grazi, Sarah LeBarron, William Leith, Nora Paxton, Elizabeth Potamites, Adele Rizzuto, and Javier Rodriguez).

MIHOPE-Strong Start was a large and complex project, and this report benefited not only from those who contributed directly to it but also from those who made this evaluation possible. A number of experts in the field provided advice and insights in designing MIHOPE-Strong Start and planning for data collection. They include Mary Kay Fox, Martha Kovac, and Diane Paulsell at Mathematica Policy Research. Additionally, Joel Gordon and Angelica Manigbas at MDRC provided advice about data security; Rose Kob, Danielle-Ann Thomas, and Ellen Fried reviewed many documents predominantly related to administrative data acquisition; and Amy Nowell and the MDRC Institutional Review Board ensured the protection of the study participants and their confidential information.

In addition to the above-named staff from ACF, CMS, and HRSA, a number of people at MDRC offered guidance on the structure and content of this final report. We received thoughtful comments on early drafts from Rekha Balu, Gordon Berlin, Carolyn Hill, Ximena Portilla, and Michael Weiss at MDRC.

Finally, Patrick Cremin and Samantha Goldstein at MDRC provided excellent assistance with all aspects of producing the report. Ashley Qiang and Mallory Undestad assisted them in checking for accuracy. Jana Weinstein, Jennie Kaufman, and Alice Tufel edited the report, and Ann Kottner and Carolyn Thomas prepared it for publication.

The Authors

Executive Summary

In the United States today, the vast majority of infants are born in good health. Yet, in 2015, the United States ranked in the top 10 countries with the highest incidence of adverse birth outcomes among Organisation for Economic Cooperation and Development (OECD) nations,¹ with a low-birth-weight prevalence of 8.1 percent and a preterm birth rate of 9.6 percent.² Reducing low birth weight and preterm birth have been long-standing policy goals for the nation,³ given the well-documented financial costs as well as the short- and long-term implications of poor newborn health for compromised health and well-being in the infant's future. Moreover, socioeconomic, racial, and ethnic disparities in birth outcomes are profound and persistent, despite population-wide improvements in access to health care.

The determinants of adverse birth outcomes are complicated, reflecting a confluence of behavioral, biological, psychosocial, and structural factors, in addition to medical risk factors. A shared understanding of these determinants has led to calls for more research to illuminate the potential of nonmedical strategies to improve newborn health in relation to mothers who are at disproportionate risk of experiencing adverse birth outcomes. Evidence-based home visiting for low-income pregnant women represents one such strategy. In providing education and support to at-risk families and connecting families to community-based resources, home visiting may be uniquely positioned to address the complexity of risk often found among low-income women.

Promoting healthy births is but one goal among many targeted by early childhood home visiting programs. Accordingly, there is a large body of rigorous research examining the impacts of home visiting on parenting behaviors, child health, child development, and family functioning. Yet, to date, rigorous investigations of home visiting's effectiveness in improving prenatal health and birth outcomes have been limited to a few trials, and the results have been inconsistent. Specifically, individual studies of Healthy Families America (HFA) and Nurse-Family Partnership (NFP) have found reductions in the risk of low birth weight and preterm birth, but this evidence is limited because these

¹Organisation for Economic Cooperation and Development, *Health at a Glance 2017: OECD Indicators*. Paris: OECD Publishing (2017), www.oecd-ilibrary.org.

²Joyce A. Martin, Brady E. Hamilton, Michelle J. K. Osterman, Anne K. Driscoll, and T. J. Mathews, "Births: Final Data for 2015," *National Vital Statistics Reports* 66, 1 (2017). Infants who are born before 37 weeks of gestation are considered preterm. Infants who weigh less than 2,500 grams (or 5.5 pounds) are considered low birth weight.

³Office of Disease Prevention and Health Promotion, "About Healthy People" (2018), www.healthypeople.gov/2020/About-Healthy-People.

positive findings have not been replicated across other studies or have been concentrated primarily in subgroups of families. Moreover, sample sizes in prior studies have often been small, making it difficult to detect effects, particularly on relatively rare outcomes such as preterm birth and low birth weight, where the impacts would have to be proportionately larger to be estimated precisely. Furthermore, earlier research has not often provided systematic information on whether home visiting programs have been structured and implemented in ways that could support the improvement of birth outcomes. Given the societal, medical, and financial import of improving birth outcomes among those at greater risk, a new test of whether evidence-based home visiting programs improve newborn health, including a deeper look at how these programs are being implemented, was warranted.

Launched in 2012, the Mother and Infant Home Visiting Program Evaluation-Strong Start (MIHOPE-Strong Start) was a large-scale examination that rigorously tested the effectiveness of evidence-based home visiting in improving birth as well as health outcomes during pregnancy and in the year after birth. Local programs included in the study's analysis implemented one of two evidence-based models: HFA and NFP. These models were chosen because earlier evaluations found some evidence of their having positive impacts on birth outcomes. At the time the study began, these were the only evidence-based home visiting models to have found positive effects on improving birth outcomes, according to the Home Visiting Evidence of Effectiveness (HomVEE) review.⁴ The Office of Planning, Research, and Evaluation (OPRE) of the Administration for Children and Families (ACF) partnered with the Center for Medicare and Medicaid Innovation (CMMI) of the Centers for Medicare and Medicaid Services (CMS) and the Maternal and Child Health Bureau (MCHB) of the Health Resources and Services Administration (HRSA) to sponsor the study. MIHOPE-Strong Start was part of the CMMI's Strong Start for Mothers and Newborns Initiative, which evaluated whether enhanced, nonmedical prenatal interventions, when provided in addition to routine medical care, have the potential to improve birth outcomes and reduce health care costs for women enrolled in Medicaid or the Children's Health Insurance Program (CHIP).⁵ MDRC led MIHOPE-Strong Start in collaboration with James Bell Associates, Johns Hopkins University, Mathematica Policy Research, and New York University.

⁴In 2009, the U.S. Department of Health and Human Services (HHS) launched HomVEE to conduct a thorough and transparent review of the home visiting research literature and assess whether home visiting models meet HHS's criteria for evidence of effectiveness (see <https://homvee.acf.hhs.gov>). The HomVEE website presents detailed information about all of the studies HomVEE has reviewed, providing an inventory of existing evidence across multiple domains related to early childhood health and well-being.

⁵Hereafter, "Medicaid" refers to either Medicaid or CHIP.

This fifth and final report of MIHOPE-Strong Start presents implementation and impact results.⁶ Specifically, it investigates the following research questions:

- What are the characteristics of the local programs and families included in the study?
- How are the local programs structured and how are front-line staff members supported in the delivery of home visiting services? What services did program group families receive, and what explains the variation in services delivered?
- What are the effects of home visiting programs on improving prenatal health, reducing low birth weight and preterm birth, and promoting preventive infant health care use? How do the effects on families vary according to family risk factors and across local programs?

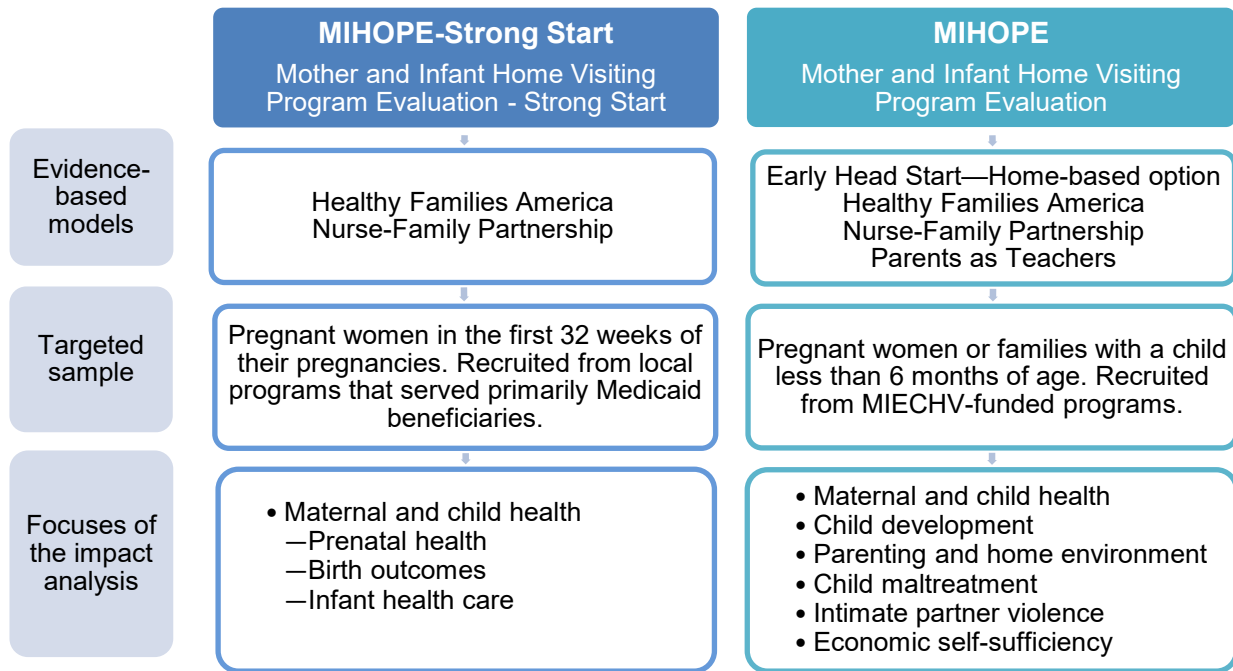
Whereas MIHOPE-Strong Start examined the relationship between home visiting and birth outcomes among HFA and NFP programs, a separate study called the Mother and Infant Home Visiting Program Evaluation (MIHOPE) is providing a broader investigation of evidence-based home visiting implementation and effectiveness. MIHOPE is the legislatively mandated evaluation of the Maternal, Infant, and Early Childhood Home Visiting (MIECHV) program.⁷ As shown in Figure ES.1, MIHOPE examined a range of outcome domains beyond those examined in MIHOPE-Strong Start. In addition to HFA and NFP, MIHOPE also included programs implementing two other widely used evidence-based home visiting models: Early Head Start — Home-based option (EHS) and Parents as Teachers (PAT). Findings from MIHOPE, including

⁶For more information and to view earlier publications from MIHOPE-Strong Start, see www.mdrc.org/project/mother-and-infant-home-visiting-program-evaluation-mihope-strong-start and www.acf.hhs.gov/opre/research/project/mother-and-infant-home-visiting-program-evaluation-strong-start-mihope-ss.

⁷In 2010, Congress authorized the Maternal, Infant, and Early Childhood Home Visiting (MIECHV) program by enacting section 511 of the Social Security Act (42 U.S.C. § 711), which also appropriated funding for fiscal years 2010 through 2014 (§ 511[42 U.S.C. 711](j)(1)). Subsequently enacted laws extended funding for the program through fiscal year 2022; specifically, section 209 of the Protecting Access to Medicare Act of 2014, Pub. L. 113-93 (fiscal year 2015); section 218 of the Medicare Access and Children's Health Insurance Program Reauthorization Act of 2015, Pub. L. 114-10 (fiscal years 2016-2017); and section 50601 of the Bipartisan Budget Act of 2018, Pub. L. 115-123 (fiscal years 2018-2022). For more information about the MIECHV program, see <https://mchb.hrsa.gov/maternal-child-health-initiatives/home-visiting-overview> and www.acf.hhs.gov/ecdc/home-visiting/tribal-home-visiting.

Figure ES.1

**Two Studies of the Effects of Evidence-Based Home Visiting:
MIHOPE-Strong Start and MIHOPE**



implementation, impact, and cost analyses, are also being published and made available on the OPRE and MDRC websites.⁸

Overview of MIHOPE-Strong Start’s Design

The recruitment process for local programs and families included in the MIHOPE-Strong Start analysis began in 2012 and ended in 2015. To be considered for the study, local programs needed to have been in operation for at least two years, be employing at least three full-time home visitors (to ensure adequate sample enrollment), and be serving a prenatal client population mostly covered by Medicaid. In addition, they had to be interested in participating, serving an area with more demand than their services could meet, and not exhibiting evidence of implementation problems. The study team directed recruitment toward local programs that were located in an environment without other comparable home visiting services, so that the control group would be unlikely to receive

⁸See www.acf.hhs.gov/opre/research/project/maternal-infant-and-early-childhood-home-visiting-evaluation-mihope or www.mdrc.org.

these services. Finally, local programs could not be located in service areas where the families they served might be receiving services under other parts of the Strong Start for Mothers and Newborns Initiative.⁹

To provide unbiased estimates of the effects of evidence-based home visiting programs, families were randomly assigned either to a program group who could receive home visiting services from the local program or to a control group whose members were given information on other services available in the community. Families were randomly assigned after the home visiting program determined that a woman was eligible and interested in the program but before she enrolled in the program.¹⁰ This was done to minimize the number of women assigned to the program group who subsequently did not receive home visiting services. Studies such as MIHOPE-Strong Start that use random assignment are designed so that the program and control groups are similar in all respects when they enter the study. As is standard in random assignment studies, the primary analytical strategy is to compare the outcomes for the program group with those of the control group. Differences that emerge after random assignment can then be reliably attributed to the program group's access to the intervention, which, in the case of MIHOPE-Strong Start, consisted of evidence-based home visiting services provided through the HFA and NFP programs in the study.¹¹

Women were eligible for MIHOPE-Strong Start if they were no more than 32 weeks pregnant, were age 15 or older, spoke English or Spanish with enough proficiency to provide informed consent, and were eligible for and interested in receiving home visiting services. Although 32 weeks into a woman's pregnancy is a relatively late time for the programs to influence birth outcomes, this cutoff point was chosen based

⁹Other approaches being tested to improve birth outcomes for women enrolled in Medicaid under CMMI's Strong Start Initiative included providing enhanced prenatal care services in group settings, providing peer counselors at birth centers, and offering access to maternity care homes. See <https://innovation.cms.gov/initiatives/Strong-Start-Strategy-2/index.html>.

¹⁰Since receiving home visiting services and participating in the study were voluntary, the women included in the program and control groups were both eligible for and interested in having home visits. Nonetheless, the study team's discussions with local programs indicated that families generally did not seek out home visiting services on their own but instead were referred to home visiting by another agency, such as the Women, Infants, and Children nutrition program.

¹¹Because some program group families might receive no home visits and some control group families might receive similar services, the effects on outcomes in MIHOPE-Strong Start depend on the extent to which program group and control group families received different amounts of home visiting services. Information about the home visiting services received by program group families is discussed later in this Executive Summary.

on findings from a study of birth outcomes in the Healthy Families New York program.¹² Most women completed study enrollment much earlier in their pregnancies, and most women in the program group (70 percent) received the first home visit in the first or second trimester.¹³

As described in an earlier report, the initial goal of the study was to recruit 15,000 families across 100 local HFA or NFP programs.¹⁴ This ambitious goal was based in part on the relative rarity of the birth outcomes of interest and in part on actuarial calculations of the sample size needed to detect reductions in Medicaid costs due to improved birth outcomes. However, it soon became clear that recruiting such a large sample of programs and families in the time frame of the study would not be possible. For the study to achieve the initial targeted number of families, almost every eligible program approached by the recruitment team would have had to agree to participate in MIHOPE-Strong Start and complete all phases of the recruitment process. Upon conducting further analyses, the study team projected that a sample size of about 3,400 families from 75 local programs was realistic to obtain and would still allow for examination of the study's key questions of interest, although reducing the sample size reduced the confidence with which the study can detect effects on relatively rare outcomes, such as birth outcomes.

Though falling short of the initial recruitment goals, MIHOPE-Strong Start analyzes information from a final sample of 2,900 families across 66 local HFA or NFP home visiting programs in 17 states. These final sample size numbers are close to the revised projected targets of 3,400 families and 75 programs. As such, MIHOPE-Strong Start is the largest random assignment study to date to examine the effectiveness of home visiting services on improving birth outcomes, prenatal and maternal health behaviors,

¹²Eunju Lee, Susan D. Mitchell-Herzfeld, Ann A. Lowenfels, Rose Greene, Vajeera Dorabawila, and Kimberly A. DuMont, "Reducing Low Birth Weight Through Home Visitation: A Randomized Controlled Trial," *American Journal of Preventive Medicine* 36, 2 (2009): 154-160.

¹³Among mothers in the program group, 20 percent received the first home visit in the first trimester and 50 percent received the first home visit in the second trimester. A small group received the first visit in the third trimester (15 percent) or after the baby was born (1 percent), and some never received a home visit (14 percent). Among the program group women who received the first home visit at some point during pregnancy, the average gestational age was 20 weeks and the median was 19 weeks. While entering the study later in pregnancy limits the number of home visits one would be expected to receive, most program group mothers who enrolled in the third trimester received at least one home visit during pregnancy.

¹⁴Helen Lee, Sarah Crowne, Kristen Faucetta, and Rebecca Hughes, *An Early Look at Families and Local Programs in the Mother and Infant Home Visiting Program Evaluation-Strong Start: Third Annual Report*, OPRE Report 2016-37 (Washington, DC: Office of Planning, Research and Evaluation, Administration for Children and Families, U.S. Department of Health and Human Services, 2016).

and health care use in the first year after birth.¹⁵ In addition, MIHOPE-Strong Start studied how home visiting programs were implemented, with a focus on understanding implementation features that could be related to improving birth outcomes.

For both the implementation and impact analyses, the study collected information directly from several data sources, including families, home visitors, local programs, and the two evidence-based model developers. Data on community characteristics of families were drawn from the U.S. Census Bureau's American Community Survey and the information on health care resources provided on HRSA's Data Warehouse. Service delivery data were gathered from management information system data and service delivery logs completed weekly by home visitors. Outcome measures were based on vital records and Medicaid data provided by state agencies.

Characteristics of the Local Programs and Families

Local programs in MIHOPE-Strong Start were large, with about 70 percent reporting the capacity to serve more than 100 families at any given time and employing an average of six to nine full-time home visitors, respective to the HFA and NFP programs, at the time of study recruitment.¹⁶ Since the study sought to recruit local programs that received more referrals than they could serve and were large enough to substantially contribute to the study's sample size, the programs were located primarily in urban areas. Nearly 90 percent had been in operation for six or more years. Also, almost 90 percent of local programs received some funding from the MIECHV program. The home visitors working in these programs at the time of the study were diverse in age and racial and ethnic background, and three-quarters had at least a bachelor's degree. Corresponding to the two models' expected staff qualifications, nearly all NFP home visitors were baccalaureate-prepared nurses and HFA home visitors had a minimum of a high school diploma or equivalent.

Families in the study resided in communities that, on average, had higher poverty and unemployment rates as well as lower rates of health insurance coverage than the national average or the average for urban areas in the 17 study states. However, these

¹⁵Earlier reports from MIHOPE-Strong Start referred to a total of 67 local programs. Two of the local programs, run by the same parent organization but serving different geographic areas within the region, have been combined for the purposes of the analysis in this report. This was done because some home visiting staff members provided services to families in both areas.

¹⁶According to the *National Home Visiting Resource Center's 2017 Yearbook*, the average number of full-time home visitors for HFA programs nationwide was five, compared with six among local programs in MIHOPE-Strong Start. For NFP, local programs in MIHOPE-Strong Start employed about nine full-time home visitors on average, compared with seven among programs nationwide.

communities had similar if not better levels of access to primary health care resources than the national average, which is generally consistent with urban contexts.

In addition to meeting the eligibility criteria of MIHOPE-Strong Start (including enrollment in the study by 32 weeks of pregnancy), families had to meet the eligibility criteria of the local program and the evidence-based model. According to NFP's model requirements, women who enrolled in a local NFP program had to be first-time, low-income mothers and no later than 28 weeks pregnant, although the model strongly encouraged local programs to recruit women earlier in pregnancy. Nationally, HFA programs allowed women to enroll up to and shortly after birth, but only women who were within 32 weeks of pregnancy could be eligible for MIHOPE-Strong Start. Furthermore, in accordance with the model developer, local HFA programs had the flexibility to consider risk factors for child maltreatment or other negative child outcomes in defining their eligibility criteria to prioritize and serve families with certain risk factors.

Information on the characteristics of women at the time of study entry follows:

- **On average, women entered the study at 17 weeks of pregnancy.** At the time of random assignment, 37 percent were in the first trimester, 55 percent of women were in the second trimester, and about 8 percent were early in the third trimester (between 28 and 32 weeks). Women in NFP programs entered the study almost five weeks earlier than women in HFA programs, consistent with NFP's emphasis on early enrollment.
- **On some indicators related to healthy births, women had fairly positive health profiles.** About 90 percent of women reported being in good-to-excellent health at study entry. Among women who were randomly assigned in the second or third trimester of pregnancy, nearly three-quarters had initiated prenatal care in the first trimester. Roughly 9 percent of the sample reported smoking at the time of study entry — a rate that is lower than that of comparable populations and samples in earlier HFA and NFP evaluations of birth outcomes.¹⁷
- **The sample members were disadvantaged in their sociodemographic profiles and on other indicators of well-being that are associated with a higher level of risk for poor birth outcomes.** The sample members were young, with an average age of 22 years, and

¹⁷Note that because these indicators of smoking are based on self-reports, they likely underestimate the prevalence of smoking in the sample.

had low levels of education. The majority of women were not residing with the child's biological father at the time of study entry. The prevalence of elevated depressive or anxiety symptoms was 43 percent — this is notably higher than comparable estimates at the national level but on par with other studies of home visiting programs. Slightly more than half of the sample members reported experiencing food insecurity.

Implementation Research Findings

The MIHOPE-Strong Start implementation research investigated aspects of program operations that are important for understanding how local programs were structured and how staff members were supported in providing services to program group families. This involved assessing whether the local programs and home visitors were focused on birth outcomes and reported being equipped to address the diverse types of risks found among program group families.

MIHOPE-Strong Start examined both the general features of program implementation and those related to prenatal health and birth outcomes. In addition, it looked at the services that program group families received, including the number of home visits, duration of participation, and content covered, such as the types of referrals made and topics discussed. Patterns in service receipt across family, home visitor, and local program characteristics were also observed.

Key findings from the implementation analysis follow:

- **Local programs and home visitors placed a high priority on improving a wide range of family outcomes, including but not limited to improving birth outcomes, underscoring their far-reaching areas of emphasis.** These outcomes include improving prenatal health, healthy births, and child preventive care, as well as positive parenting, child development, family planning, and maternal well-being.
- **The majority of local programs reported having policies, infrastructure, and support tools in place to help home visitors address the targeted outcomes.** For example, nearly all local programs expected home visitors to screen for and monitor pregnant women's receipt of prenatal care and to help them follow through on prenatal care providers' recommendations. And for the most part, home visitors reported feeling adequately supported by their programs' implementation systems and comfortable and effective in their roles.

- **Program group women who received at least one home visit during the study period received an average of about eight home visits over nearly four months before giving birth.** This level of home visiting receipt is consistent with the findings from earlier studies of HFA and NFP that have found positive impacts on birth outcomes,¹⁸ but the number of home visits is lower than what the evidence-based models intended. Also, about 14 percent of program group families never received a home visit either during pregnancy or after birth.
- **Among the families who received at least one home visit and for whom information was available, almost all (96 percent) discussed prenatal health with their home visitor at least once.** Prenatal health was also the most common type of referral (42 percent of families), including such areas as nutrition, substance use, and child-birth education, in addition to physician-based prenatal care.
- **Women who were more and less vulnerable to poor birth outcomes received similar levels of home visiting services.** Among women who received at least one home visit, those who exhibited risks for compromised birth outcomes (such as being of a younger age, experiencing food insecurity, reporting poor or fair health status, and being smokers) received the same number of visits and participated for similar lengths of time, on average, as women who didn't demonstrate such risks.

Effects of Home Visiting on Prenatal Health, Birth, and First-Year Health Care Use Outcomes for the Full Sample

While there were many additional prenatal health, birth, and health care use outcomes the study could have examined, the analyses focused on assessing the effects of home visiting on a prespecified, limited set of outcomes — which are referred to as “confirmatory” — to reduce the chance of a false-positive finding of effectiveness, which is more likely to happen when more outcomes are examined. The confirmatory outcomes were selected based on a review of prior evidence, policy relevance, and measurement quality. In addition, the two evidence-based models and most local programs indicated that they place a high priority on improving birth outcomes and child health and at least a

¹⁸Lee et al. (2009); David L. Olds, Charles R. Henderson, Robert Tatelbaum, and Robert Chamberlin, “Improving the Delivery of Prenatal Care and Outcomes of Pregnancy: A Randomized Trial of Nurse Home Visitation,” *Pediatrics* 77, 1 (1986): 16-28.

moderate priority on improving prenatal health. Other “exploratory” outcomes, as well as impacts on exploratory subgroups, were also included in the impact analysis. All exploratory analyses were prespecified, but the prior empirical evidence and theoretical links between home visiting and its impacts in relation to them were less clear. In addition to these analyses, the study explored whether impacts varied across local home visiting programs or by evidence-based model.

The eight confirmatory outcomes examined in MIHOPE-Strong Start are:

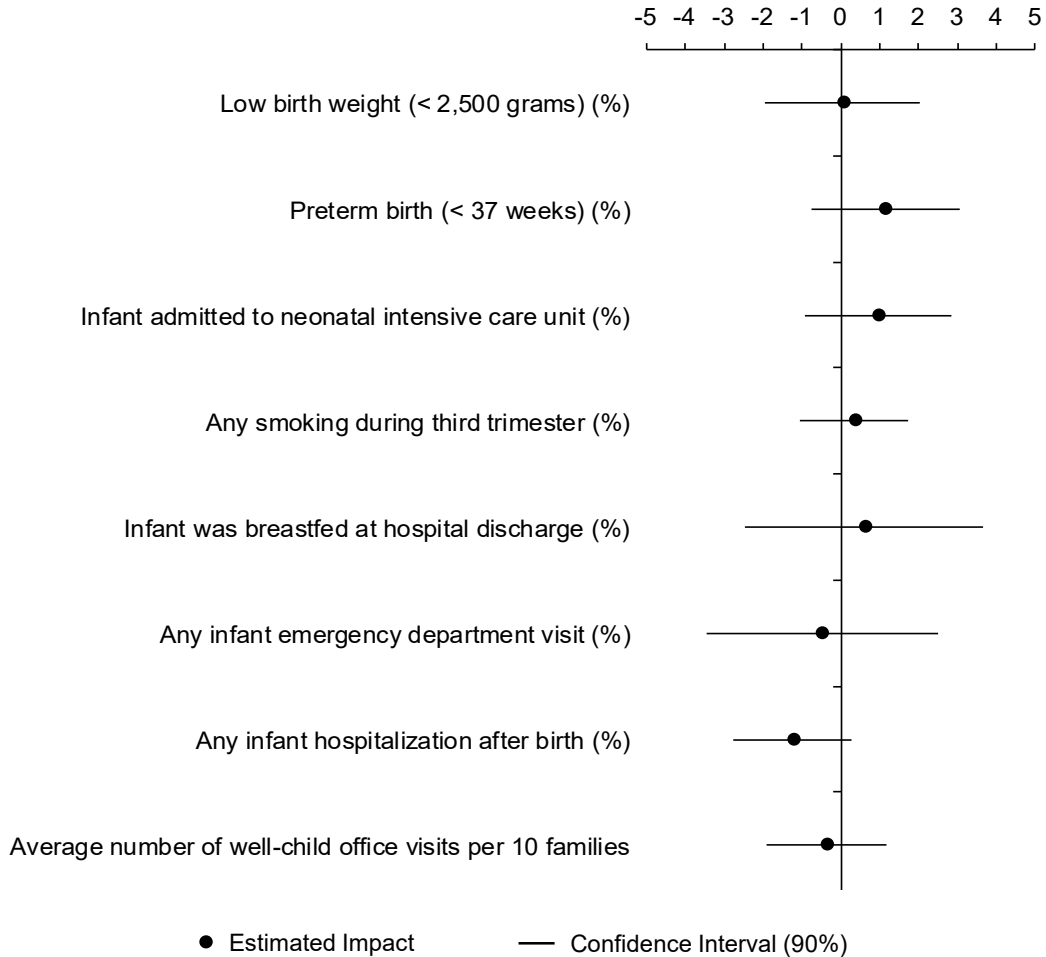
- Whether the infant was born with a low birth weight
- Whether the infant was born preterm
- Whether the infant was admitted to the neonatal intensive care unit (NICU)
- Whether the mother smoked cigarettes during the third trimester of pregnancy
- Whether the infant was breastfed at discharge from the hospital
- Whether the infant had an emergency department visit in the first year
- Whether the infant was admitted to the hospital in the first year (excluding the birth hospitalization)
- The number of Medicaid-paid well-child visits in the first year

The effects on the study’s confirmatory outcomes are shown in Figure ES.2. A guide to interpreting the estimated impacts in the figure is provided in Box ES.1. A summary of the findings follows.

- **No statistically significant effects of the home visiting services provided by the programs in the study were found on any of the eight confirmatory outcomes.** Home visiting services provided by the local HFA and NFP programs in MIHOPE-Strong Start did not significantly decrease rates of low birth weight, preterm birth, or admission to a NICU, nor did they decrease smoking in the last trimester of pregnancy. There were also no statistically significant effects of home visiting on breastfeeding at hospital discharge or on infant health care use outcomes during the first year of life.

Figure ES.2

Effects on MIHOPE-Strong Start Confirmatory Outcomes



SOURCES: Calculations based on state vital records and Medicaid enrollment and claims data.

NOTES: The scale represents the difference in percentage points between the program group and the control group for the first seven outcomes and the difference in number of visits for the last outcome. See Box ES.1 for more explanation.

Estimates were regression-adjusted using generalized least squares, controlling for pre-random assignment characteristics of sample members weighted to adjust for differing random assignment ratios used in MIHOPE and MIHOPE-Strong Start. Sample sizes vary depending on the data source and measure.

Infant emergency department visits, hospitalizations, and well-child visits are based on Medicaid-paid health care use from birth until the first birthday.

Box ES.1

How to Interpret Estimated Impacts

The effects, or impacts, of home visiting are estimated by comparing outcomes for the program and control groups, adjusted for the background characteristics of the sample members. Figure ES.2 shows the estimated impacts for the study's confirmatory outcomes as dots. For example, 11.7 percent of births in the program group and 11.6 percent of births in the control group were low birth weight, resulting in an estimated impact of 0.1 percentage point (found by subtracting 11.6 percent from 11.7 percent).

The horizontal lines on either side of the dots showing the estimated impact in Figure ES.2 represent the 90 percent confidence interval, which is an estimate of the variability (or statistical imprecision) of the impact of the home visiting programs. A shorter confidence interval suggests a more precise estimate of the population parameter than a wider confidence interval, which indicates greater variability and, thus, greater uncertainty. A confidence interval that does not contain zero — that is, it is fully to the right or the left of the zero line — indicates that the impact is statistically significantly different from zero at the 10 percent level.

- **Home visiting provided by the programs in the study did not appear to have larger effects on birth outcomes, prenatal behaviors, or health care use after birth for any subgroups of families.** The analysis also compared program impacts on confirmatory outcomes by maternal race and ethnicity, by whether the mother smoked prior to pregnancy, by the mother's stage of pregnancy at study entry, and by maternal age. In general, the impacts did not differ between the program and control groups for these subgroups, suggesting that home visiting did not have a differential effect on higher- and lower-risk families.
- **The effects of home visiting on birth outcomes, prenatal behaviors, and health care use after birth did not vary across local programs in MIHOPE-Strong Start.** There is no evidence that impacts differ by how local programs were implemented or by evidence-based model.

Discussion

The large-scale examination produced by MIHOPE-Strong Start provides important new information about the effects of two evidence-based home visiting models, HFA and NFP, on improving prenatal health, birth outcomes for families, and health care use in infancy. While a separate report from MIHOPE presents the impacts of home visiting across a broader range of child and maternal outcomes and for two additional evidence-based models, the findings from MIHOPE-Strong Start show that the local home visiting programs in the study did not have a discernible effect on prenatal health and birth outcomes or on infant health care use.

Low birth weight and preterm birth are still relatively uncommon events in the United States. Even in a large sample, like the one in MIHOPE-Strong Start, the number of children born prior to 37 weeks of gestation or weighing less than 5.5 pounds is usually small. With a sample of 2,900 mothers, this study was designed to reliably detect differences of a reduction of 2.8 percentage points in the rate of low birth weight and a reduction of 2.5 percentage points for preterm births. The impacts estimated by MIHOPE-Strong Start — 0.1 percentage point and 1.1 percentage point, respectively — are much smaller than these levels and are not statistically significant.

It is important to note some of the limitations to the findings in this report. As with all evaluations, the estimates from MIHOPE-Strong Start are specific to this sample of local programs and families, which, while racially, ethnically, and geographically diverse, is not necessarily representative of all HFA and NFP programs. Furthermore, when the study began in 2012, the MIECHV program had recently been launched. Most (57) of the local programs included in MIHOPE-Strong Start received some funding from the MIECHV program, which created changes in local program priorities and monitoring requirements that might have resulted in their implementation evolving over time. For example, the MIECHV program includes a number of efforts that encourage continuous quality improvement in awardees and for awardees' local programs. The findings here should be understood within this broader policy context.

As noted earlier, the study's impact analysis compared outcomes for all program group and control group families, following best practices in a random assignment study. Given that 14 percent of program group families received no home visits, the effects would be about 16 percent larger if the analysis had estimated the effects

among families who received at least one home visit.¹⁹ However, the conclusions based on statistical significance would be unaltered.

While there are advantages of using administrative data for measuring outcomes, as was done in MIHOPE-Strong Start, there are also limitations. For example, it is known that the information provided on birth records tends to underreport the mother's smoking. Thus, the smoking outcomes examined are likely underestimates of true prevalence. It is also important to keep in mind that the service delivery measures examined in the implementation analysis — including the amount of home visiting and duration of participation — capture aspects that are distinct from the quality of home visiting services received.

There are several reasons why home visiting might not have been effective at improving the birth outcomes examined in this study. First, the families in MIHOPE-Strong Start, while disadvantaged in their sociodemographic profiles, tended to have healthy behaviors and sufficient access to health care — important factors in healthy pregnancies and birth outcomes — prior to enrolling in the study. For example, few women in the study smoked during pregnancy and most of the sample had access to health care providers.

Second, it is possible that control group families had access to home visiting programs outside the immediate neighborhood and to other effective services,²⁰ despite recruitment that prioritized local programs in an environment without other comparable evidence-based home visiting. MIHOPE-Strong Start did not gather data on the services that all control group members received after random assignment, but MIHOPE did collect information on service use among control group families to shed light on this issue. In MIHOPE, about 20 percent of women assigned to the control group indicated that they had received home visiting or parenting services in the year prior to completing a follow-up survey, which was conducted around the time the child was 15 months old. Additionally, 9 percent of control group families in MIHOPE indicated that they had re-

¹⁹For a given impact equal to 1 for the full sample, the impact for the 86 percent of program group families who received at least one home visit can be estimated by dividing the full-sample impact by 0.86. This assumes the impact is 0 for the 14 percent of program group members who received no home visits. As a result, the impact among those who received a home visit is about 16 percent ($1 / 0.86$) larger than for the full sample.

²⁰For a description of other state-based initiatives to improve birth outcomes across the 17 states in MIHOPE-Strong Start, see Mariel Sparr, Alexandra Joraanstad, Grace Atukpawu-Tipton, Nicole Miller, Julie Leis, and Jill Filene, *Promoting Prenatal Health and Positive Birth Outcomes: A Snapshot of State Efforts*, OPRE Report 2017-65 (Washington, DC: Office of Planning, Research and Evaluation, Administration for Children and Families, U.S. Department of Health and Human Services, 2017).

ceived behavioral health services, about 3 percent had received intimate partner violence services, and about 4 percent of children had received early intervention services. As part of the study protocol, MIHOPE-Strong Start control group families were given information on other types of services in the community, which covered areas such as pregnancy, substance abuse, housing, and food and nutrition; less frequently, they were given information on a home visiting program that was more limited in scope.

Another consideration is that due to the study requirements described earlier, the programs in MIHOPE-Strong Start recruited a sample of women residing in primarily urban areas who likely had greater access to alternative services. Thus, the findings may not be generalizable to programs that operate in areas where access to prenatal health care and other services is more limited.

An additional reason for the study's lack of impacts could be that although program group families received a level of home visiting services similar to levels reported in previous trials of HFA and NFP, most families in the program group received fewer home visits than the evidence-based models prescribed, including 14 percent of families who received no home visits at all. While impacts were not larger in local programs where families received more home visits, this may in part be because there were not large differences in local programs' ability to keep families engaged.

Future research could investigate these possibilities by studying such factors as whether home visiting would have a greater effect on birth outcomes if it were to use new approaches to engaging families in a high level of services; to target services to mothers who are engaged in risky behaviors associated with compromised birth outcomes, such as smoking, or to women who are not connected to community and safety net programs; and to study the effects of home visiting in rural areas.

Finally, research on the epidemiology of newborn health suggests that it is challenging for any single intervention to improve birth outcomes.²¹ Scholars have increasingly focused on the role of stress — especially the cumulative exposure to stress — in altering the physiology of the fetal environment among low-income and racial minority women.²² This research points to an important but more distal mechanism that could

²¹Institute of Medicine (U.S.) Committee on Understanding Premature Birth and Assuring Healthy Outcomes, *Preterm Birth: Causes, Consequences, and Prevention* (Washington, DC: National Academy of Sciences, 2007).

²²Michael C. Lu, Milton Kotelchuck, Vijaya Hogan, Loretta Jones, Kynna Wright, and Neal Halfon, "Closing the Black-White Gap in Birth Outcomes: A Life-Course Approach," *Ethnicity and Disease* 20, 1, S2 (2010): 62-76; Michael S. Kramer, Louise Seguin, John Lydon, and Lise Goulet, "Socio-Economic Disparities in Pregnancy Outcome: Why Do the Poor Fare So Poorly?" *Paediatric and Perinatal Epidemiology* 14, 3 (2000): 194-210.

affect birth outcomes, given that the effects of chronic stress can be long-lasting.²³ While home visiting during pregnancy may not be enough to mitigate the negative impacts of stress on the current birth, home visitors' ongoing interactions and supportive role with families could reduce maternal stress and improve resiliency in the long run, thereby improving maternal and child health in the future.

Relatedly, to the extent that the local programs in this evaluation were able to improve the mother's health and well-being after the focal child's birth, there may be longer-term impacts of home visiting on future births. Researchers have increasingly emphasized the importance of health and care before pregnancy in improving newborn health,²⁴ although finding ways to intervene with women before they become pregnant is a persistent challenge. Home visiting thus has the potential to reach women and provide services between pregnancies in ways such as encouraging spacing between pregnancies and increasing families' economic self-sufficiency; these types of modifications might lead to improvements in maternal health and better birth outcomes.

²³Margaret Comerford Freda, Merry-K. Moos, and Michele Curtis, "The History of Preconception Care: Evolving Guidelines and Standards," *Maternal and Child Health Journal* 10, 1 (2006): 43-52.

²⁴Freda, Moos, and Curtis (2006).

Chapter 1

Introduction

Most newborns in the United States today are born in good health. Some infants, however, begin life at a health disadvantage, entering the world several weeks before their due date or weighing less than 5.5 pounds.¹ In 2015, 9.6 percent of infants in the United States were born preterm and 8.1 percent were born with low birth weights.² This health disadvantage at birth can carry numerous and cumulative consequences for compromised health and development throughout childhood and into adulthood.³ In turn, these health and development consequences exact emotional tolls on families and financial costs for both families and the health care system.⁴ The risk of delivering an infant who is born preterm or with low birth weight has persistently been higher among women with low incomes and low educational attainment and among women of African-American and Puerto Rican descent.⁵ Efforts to improve birth outcomes at the population level thus call for strategies that can address the disproportionate risk found among women who are socially and economically disadvantaged.

Although the exact causes of preterm birth and low birth weight remain unknown, common explanations for the greater risk found among low-income women include poor maternal health; negative health behaviors (for example, smoking, alcohol consumption,

¹Infants who are born before 37 weeks of gestation are considered preterm. Infants who weigh less than 2,500 grams (or 5.5 pounds) are considered low birth weight.

²Martin et al. (2017). Earlier reports from MIHOPE-Strong Start cited a national preterm birth prevalence of over 11 percent. The national standard by which to measure gestational age at birth based on birth certificate information changed beginning with the 2014 data year: States now base their measurements on the obstetric estimate or a comparable clinical estimate, whereas before they based them on the date of the mother's last menstrual period. The change in the national standard has resulted in a lower preterm birth rate. For example, in 2015 the preterm birth rate in the United States based on the last menstrual period measure was 11.3 percent, compared with a preterm birth rate of 9.6 percent found using the obstetric estimate. This transition was made because the obstetric estimate has greater accuracy for assessing gestational age at birth than measures based on the last menstrual period (Martin, Osterman, Kirmeyer, and Gregory, 2015).

³Conley and Bennett (2000); Institute of Medicine (U.S.) Committee on Understanding Premature Birth and Assuring Healthy Outcomes (2007); Petrou, Sach, and Davidson (2001).

⁴Institute of Medicine (U.S.) Committee on Understanding Premature Birth and Assuring Healthy Outcomes (2007).

⁵Blumenshine et al. (2010); David and Collins (1997); Dominguez (2011); Fuentes-Afflick and Lurie (1997); Institute of Medicine (U.S.) Committee on Understanding Premature Birth and Assuring Healthy Outcomes (2007); Lu and Halfon (2003); Parker, Schoendorf, and Kiely (1994); Rossen and Schoendorf (2014).

and drug use); lack of adequate prenatal health care; limited material resources; lack of social support; exposure to stress; and residing in communities with characteristics that are associated with worse health outcomes, such as higher rates of poverty and poor housing conditions.⁶ Many of these potential contributors to adverse birth outcomes co-occur.⁷ While no single intervention can mitigate all such risks, evidence-based home visiting for low-income pregnant women has been identified as one possible strategy to improve newborn health. By providing families individually tailored services focused on offering education and support, assessing and screening for risks, and connecting families to community-based resources, evidence-based home visiting may be uniquely positioned to address the complex nature and concentration of risk often found among low-income women.

To investigate the potential of home visiting as a strategy to improve birth outcomes among low-income women, the Office of Planning, Research, and Evaluation (OPRE) of the Administration for Children and Families (ACF) partnered with the Center for Medicare and Medicaid Innovation (CMMI) of the Centers for Medicare and Medicaid Services (CMS) and the Maternal and Child Health Bureau (MCHB) of the Health Resources and Services Administration (HRSA) to conduct a rigorous evaluation called the Mother and Infant Home Visiting Program Evaluation-Strong Start (MIHOPE-Strong Start). MIHOPE-Strong Start was part of CMMI's Strong Start for Mothers and Newborns Initiative, which tested and evaluated whether enhanced, nonmedical prenatal interventions, when provided in addition to routine obstetrical medical care, have the potential to improve birth outcomes and reduce health care costs for women enrolled in Medicaid or the Children's Health Insurance Program (CHIP).⁸ MDRC led MIHOPE-Strong Start in partnership with James Bell Associates, Johns Hopkins University, Mathematica Policy Research, and New York University.

With a sample of 2,900 families across 66 local home visiting programs in 17 states, MIHOPE-Strong Start is the largest random assignment study to date to rigorously examine the effectiveness of home visiting services in improving birth outcomes, prenatal and maternal health behaviors, and the use of health care in the first year after birth.⁹ The local programs in the study used one of two widely implemented models:

⁶Institute of Medicine (U.S.) Committee on Understanding Premature Birth and Assuring Healthy Outcomes (2007); Kramer, Seguin, Lyndon, and Goulet (2000); Lu and Halfon (2003).

⁷Institute of Medicine (U.S.) Committee on Understanding Premature Birth and Assuring Healthy Outcomes (2007).

⁸For brevity, "Medicaid" is used to indicate Medicaid or CHIP in the remainder of the report.

⁹Earlier reports from MIHOPE-Strong Start referred to a total of 67 local programs. Two of the local programs, run by the same parent organization but serving different geographic areas within the

Healthy Families America (HFA) and Nurse-Family Partnership (NFP). These two models were chosen because prior studies have shown some evidence of their having favorable effects on birth outcomes. In addition to studying the effects of home visiting, MIHOPE-Strong Start looked at how home visiting programs were implemented, with a focus on how they were implemented in ways that could support the improvement of birth outcomes.

This fifth and final report from MIHOPE-Strong Start presents final implementation and impact results from the six-year research effort that began in 2012. In so doing, it builds upon earlier reports that respectively:

- described the study design and reviewed key elements of the two evidence-based models included in MIHOPE-Strong Start;¹⁰
- documented the study team’s process for acquiring administrative records across many states, including birth records, fetal death certificates, and Medicaid information, all of which were used to assess the impacts of home visiting programs on birth outcomes and maternal and infant health care use;¹¹
- presented an overview of the study’s recruitment efforts for the sample population as well as an early portrait of the families, home visitors, and local programs in the study;¹² and
- summarized findings from qualitative interviews with Medicaid administrators and other state entities involved in efforts to promote prenatal health and positive birth outcomes, including but not limited to home visiting, conducted in states participating in MIHOPE-Strong Start.¹³

region, have been combined for the purposes of the analysis. This was done because some home visiting staff members provided services to families in both areas.

¹⁰Filene et al. (2013). Available on the Office of Planning, Research, and Evaluation website: https://www.acf.hhs.gov/sites/default/files/opre/mihope_ss_final_12_24_13.pdf.

¹¹Lee, Warren, and Gill (2015). Available on the Office of Planning, Research, and Evaluation website: https://www.acf.hhs.gov/sites/default/files/opre/mihope_strongstart_2yr_2015.pdf.

¹²Lee, Crowne, Faucetta, and Hughes (2016). Available on the Office of Planning, Research, and Evaluation website: https://www.acf.hhs.gov/sites/default/files/opre/mihope_ssy3_acf_compliant.pdf.

¹³Sparr et al. (2017). Available on the Office of Planning, Research, and Evaluation website: https://www.acf.hhs.gov/sites/default/files/opre/2017_mihope_strong_start_final_with_revised_footnote_508.pdf.

Much background information has been covered in the previous reports. However, a brief review of the study's motivation and design is presented below. This includes a summary of what has been learned from prior evaluations of HFA and NFP that examined birth and related outcomes as well as a discussion of the potential ways home visiting could improve such outcomes. The chapter concludes by briefly describing the study design, data sources, and specific questions to be answered in each of the subsequent chapters.

Home Visiting and Birth Outcomes: Existing Knowledge and Gaps

At its core, MIHOPE-Strong Start was designed to test the effectiveness of evidence-based home visiting services in improving birth outcomes for women who were enrolled in Medicaid. Because individuals must have low incomes to be eligible for Medicaid, participants in this program were at a higher risk of adverse birth outcomes than privately insured women.¹⁴ Similarly, both HFA and NFP target home visiting services to families who are disadvantaged, as indicated by low-income status, single parenthood, young age, or the presence of psychosocial and material stressors. These characteristics may, simultaneously, indicate families with greater health risk.

Key Components of Home Visiting

Home visitors generally provide education and support to families. This is accompanied by two additional activities: information gathering (consisting of assessment and screening of family risks and needs) and referral to and coordination with needed services.¹⁵ In crossing the threshold of the home, home visitors seek to establish trusting, collaborative relationships with families through a framework that focuses on identifying the strengths families possess while attuning to the particular context of the home environment and each family's risks and needs.¹⁶

As the programs were designed, home visitors in this study were expected to promote behaviors that would improve maternal and child health and positive parenting practices and foster child well-being.¹⁷ In addition to playing an educational and social support role, home visitors were expected to assess mental health, behavioral health,

¹⁴Markus et al. (2017).

¹⁵Michalopoulos et al. (2015).

¹⁶Duggan et al. (1999); Duggan et al. (2018).

¹⁷Filene et al. (2013); Lee, Crowne, Faucetta, and Hughes (2016).

and intimate partner violence concerns and link families to resources to address any risks related to these areas that might be detected. They were also expected to connect families to resources concerning other unmet needs, such as housing and food assistance.¹⁸ Home visiting that begins during pregnancy and continues after birth could thus potentially address a range of factors that positively influence prenatal, newborn, and infant health. These practices include improving access to and encouraging the appropriate use of health care, promoting good nutrition, and addressing the importance of abstinence from harmful substances.

Prior Evidence Related to Birth Outcomes

As two of the most widely scaled evidence-based home visiting models in the country, HFA and NFP are among the most widely evaluated, with numerous studies analyzing program effectiveness across a range of outcomes, such as child development, parent-child interactions, child maltreatment, and family economic self-sufficiency.¹⁹ Despite a rich literature on program effectiveness across other domains of family well-being, rigorous investigations of whether HFA and NFP improve birth outcomes are limited to five randomized controlled trials (RCTs).²⁰ One of the studies, an evaluation of HFA conducted from 2000 to 2002, found that program group mothers in three communities in New York State who enrolled at a gestational age of 30 weeks or less were about half as likely to deliver low-birth-weight infants as mothers in the control group.²¹ Notwithstanding this large and statistically significant reduction in low birth weight, the study did not find statistically significant impacts on reducing preterm births²²

¹⁸As discussed further in this report, these were only some of the broad goals that the home visitors were expected to address; others could include maternal education and employment.

¹⁹In 2009, the U.S. Department of Health and Human Services (HHS) launched HomVEE to conduct a thorough and transparent review of the home visiting research literature and assess whether home visiting models met HHS's criteria for evidence of effectiveness (see <https://homvee.acf.hhs.gov>). The HomVEE website presents detailed information about all of the studies HomVEE has reviewed, providing an inventory of existing evidence across multiple domains related to early childhood health and well-being. As of June 2018, HomVEE had identified a total of 63 studies from HFA and 36 studies from NFP related to evidence-based models, with 23 of the HFA studies and 24 of the NFP studies rated as moderate or high quality.

²⁰At the time that MIHOPE-Strong Start was launched, HFA and NFP were the only evidence-based models to have shown positive effects on birth outcomes according to the HomVEE review. In July 2015, HomVEE was updated to include a Kentucky-based home visiting model as evidence-based (called Health Access Nurturing Development Services, or HANDS), which showed positive effects on reducing low birthweight and preterm birth using a quasi-experimental (non-RCT) study design.

²¹Lee et al. (2009).

²²Lee et al. (2009).

or the percentage of babies born small for gestational age.²³ The second of the studies, an RCT of NFP beginning in the late 1970s in Elmira, New York, found statistically significant reductions in preterm births but only for certain subgroups of families: smokers who consumed at least five cigarettes per day at study intake and very young mothers between the ages of 14 and 16.²⁴ The third trial, evaluating NFP between 1990 and 1991 in Memphis, Tennessee, did not find statistically significant program effects on babies born with low birth weight or preterm.²⁵ A fourth study, which was an evaluation of NFP in Denver, Colorado, that began in the mid-1990s, also did not find any statistically significant reductions in low birth weight or preterm birth.²⁶ The fifth study, which was an RCT of NFP conducted in Orange County, California, in the early 2000s, did not find statistically significant reductions in the prevalence of low birth weight but did find statistically significant reductions in preterm birth rates.²⁷

It is important to note that the study samples in two of the prior NFP trials to have found significant effects on improving birth outcomes for the full sample or for subgroups are quite small.²⁸ Furthermore, the samples of women in the NFP evaluations in Elmira and Memphis were recruited about 30 to 40 years ago, and they are different from the families recruited for MIHOPE-Strong Start, with the Elmira participants living in a small, semirural region and consisting only of white mothers and the Memphis sample being made up of primarily African-American participants. The study sample in the NFP trial in Orange County consisted of only Hispanic adolescent mothers. The sample in the HFA study is more similar to that of MIHOPE-Strong Start: About two-thirds of the sample are black or Hispanic, most had already initiated prenatal care at study entry, and half were living in a large city in upstate New York, comparable to the urban areas observed in MIHOPE-Strong Start. In addition, the HFA study was conducted about 10 to 20 years

²³Mitchell-Herzfeld et al. (2005).

²⁴Olds, Henderson, Tatelbaum, and Chamberlin (1986).

²⁵Kitzman et al. (1997).

²⁶In the first published article from the NFP trial in Denver (Olds et al., 2002), the authors did not estimate program effects on birth outcomes. However, in a 2015 meta-analysis of prior NFP evaluations, Miller gathered additional data on program effects from personal communications with the model developer and study authors. Miller calculated and published estimates of the effects of NFP on low birth weight and preterm birth prevalence from the Denver trial, and no statistically significant differences were found on either outcome (Miller, 2015).

²⁷Nguyen, Carson, Parris, and Place (2003). Estimates of statistical significance are based on calculations produced and published by Miller (2015) in a larger meta-analysis of prior NFP evaluations, as the study authors did not include this information in the original article.

²⁸Specifically, the total sample size of the NFP Orange County study was about 150 women (Nguyen, Carson, Parris, and Place, 2003). In the NFP Elmira study, the sample sizes of the subgroups where significant reductions in preterm birth were found were 142 (for the subgroup of smokers) and 45 (for the subgroup of very young mothers) (Olds, Henderson, Tatelbaum, and Chamberlin, 1986).

later than the NFP studies done in Elmira and Memphis, although it is still almost 20 years old. Thus, while the evidence produced by some of these studies is promising, it is limited to five studies conducted decades ago and mostly in different types of geographic regions from those included in MIHOPE-Strong Start.

Other examinations of home visiting's potential to improve birth outcomes have not been encouraging. A systematic review in 2011 that focused on investigating the role of home visiting in improving birth outcomes found little evidence of its effectiveness.²⁹ A meta-analysis of home visiting programs across six different domains supported this conclusion, finding statistically significant positive effects, on average, in areas such as maternal life course development, parenting skills, and child cognitive development but not in the domain of birth outcomes.³⁰ The authors of the 2011 review commented that while there are many rigorous home visiting studies examining outcomes in the early childhood years from which to draw, the relationship between home visiting and birth outcomes has been understudied.

Given the limited evidence of prior effectiveness in improving birth outcomes and because poor birth outcomes carry such a high cost to families and society, it is important to gain a better understanding of the potential of home visiting in this area. As the largest random assignment study of the effects of home visiting on birth outcomes, MIHOPE-Strong Start represents an important opportunity to better understand the potential of home visiting to improve the health of babies born to women with low incomes, particularly those with Medicaid coverage.

The Role of Prenatal Health and Health Care

Theoretically, improvements in birth outcomes would be tied to home visiting's effectiveness in improving prenatal health behaviors and outcomes. At the model level, HFA and NFP considered the increased use of prenatal care to be moderately high or high among their priorities, respectively.³¹ They both reported expecting home visitors to work with mothers to improve health habits during pregnancy, such as by helping them to reduce or quit smoking and the use of other harmful substances and encouraging follow-through on prenatal care provider recommendations. While it is unknown

²⁹Issel et al. (2011). Note that the review mentioned here included both experimental and nonexperimental evaluations of home visiting models and the models it used went beyond HFA and NFP, including some that do not meet the U.S. Department of Health and Human Services criteria of being evidence based.

³⁰Filene, Kaminski, Valle, and Cachat (2013).

³¹Filene et al. (2013); Lee, Crowne, Faucetta, and Hughes (2016).

whether there are particularly sensitive or critical periods during pregnancy when intervening is most fruitful for improving birth outcomes, it is known that experiencing certain behavioral risks at some point during pregnancy is associated with poor birth outcomes. It is still unclear, however, whether home visiting services can improve prenatal health and birth outcomes for mothers already enrolled in Medicaid and for those who have already started receiving prenatal care.³²

Behavioral health risk factors. As has been widely recognized, the higher risk of poor birth outcomes observed among low-income women reflects a constellation of other risk factors during pregnancy. Some of these risks are modifiable. For example, cigarette smoking is regarded as among the most preventable causes of adverse pregnancy outcomes, which result from its effects on fetal growth and the placental membrane.³³ While smoking rates among women have steadily declined over the past several decades, these declines have been much more pronounced among women with higher incomes and education, resulting in the widening of socioeconomic disparities in smoking during pregnancy.³⁴ Other behavioral factors — such as the heavy consumption of alcohol and use of illicit drugs — are known contributors to poor birth outcomes, although their specific role in the higher risk among low-income women has been difficult to pin down because these women often have multiple risk factors occurring.³⁵

The evidence as to whether home visiting improves prenatal health behaviors is promising but it is also limited, in this case to three prior studies. Specifically, three NFP trials, conducted between 20 and 40 years ago, have examined smoking during pregnancy, and two of the three found statistically significant program effects on smoking reduction.³⁶ To the authors' knowledge, only one prior study — the NFP trial conducted

³²Only one of the five prior HFA or NFP studies to have examined birth outcomes reported information on the insurance coverage of the sample at study entry. This was the NFP study conducted in Orange County, which reported that about three-quarters of the sample received Medicaid at study enrollment (Nguyen, Carson, Parris, and Place, 2003). None of the four NFP studies examining birth outcomes reported information on whether women were already receiving prenatal care prior to study entry. However, the HFA study in New York indicated that most women were receiving prenatal care when they enrolled in the study (Mitchell-Herzfeld et al., 2005).

³³Cnattingius (2004); Goldenberg, Culhane, Iams, and Romero (2008). Quitting smoking early in pregnancy is optimum, but even when this doesn't occur, infant birth weight can be improved by reducing the amount of cigarettes smoked (Li et al., 1993).

³⁴Institute of Medicine (U.S.) Committee on Understanding Premature Birth and Assuring Healthy Outcomes (2007); Singh and Kogan (2007).

³⁵Goldenberg, Culhane, Iams, and Romero (2008); Institute of Medicine (U.S.) Committee on Understanding Premature Birth and Assuring Healthy Outcomes (2007).

³⁶In the NFP study conducted in Elmira (Olds, Henderson, Tatelbaum, and Chamberlin, 1986), program group women exhibited larger reductions in the number of cigarettes they smoked than did

in Elmira — examined other behavioral risks during pregnancy, specifically alcohol consumption, and found no statistically significant difference across study groups.³⁷

Use of prenatal care. Early initiation and adequate use of prenatal health care are important for improving pregnancy health in that they enable the diagnosis of emergent health complications and addressing risky health conditions.³⁸ Timely use of prenatal care has steadily improved over the past few decades, with the greatest gains seen among groups who have historically had less timely care, including black and Hispanic women.³⁹ Nationally, over three-quarters of women initiated prenatal care by the first trimester in 2016.⁴⁰ Studies of Medicaid-specific populations have found similarly high rates of early initiation.⁴¹ Information on the adequacy of prenatal care, which takes into account both the timing of initiation and the number of visits received, suggests that the majority of women covered by Medicaid receive adequate prenatal care, although at somewhat lower rates than women not covered by Medicaid.⁴²

The evidence of whether HFA or NFP improves prenatal health care use is limited to three trials, none of which found program effects. An HFA trial did not find a statistically significant difference between program and control groups in the average number of prenatal care visits during the third trimester.⁴³ Neither of the two NFP trials that presented impacts on prenatal care receipt found statistically significant differences between the study groups in terms of the average number of prenatal care visits made by the end of pregnancy.⁴⁴

smokers in the comparison group (as self-reported by mothers and confirmed through an analysis of serum cotinine levels in blood that was routinely collected for a subsample of women receiving prenatal care at a public health clinic). Also, in the NFP study conducted in Denver, program group women had significantly greater reductions in urine cotinine levels than the control group (Olds et al., 2002). Miller (2015) published previously unavailable estimates from the NFP Memphis trial (Kitzman et al., 1997) on self-reported smoking behavior, and no statistically significant reductions in the number of cigarettes smoked over pregnancy were found.

³⁷Olds, Henderson, Tatelbaum, and Chamberlin (1986).

³⁸National Institute of Child Health and Human Development (2017).

³⁹Alexander, Kogan, and Nabukera (2002); Lu et al. (2010); Martin et al. (2010). Scholars have cautioned that the narrowing of racial and ethnic differences in prenatal care receipt, albeit important, does not necessarily mean that the quality of care received is the same.

⁴⁰Osterman and Martin (2018).

⁴¹Centers for Medicare and Medicaid Services (2016).

⁴²Pregnancy Risk Assessment Monitoring System (PRAMS) Data Portal (2018); information taken from the 2011 data set.

⁴³Mitchell-Herzfeld et al. (2005).

⁴⁴Kitzman et al. (1997); Olds, Henderson, Tatelbaum, and Chamberlin (1986).

Health and Health Care After Birth

In addition to encouraging prenatal health and healthy births, the evidence-based models included in MIHOPE-Strong Start emphasize the importance of promoting practices to improve infant health. For example, both HFA and NFP prioritized the promotion of breastfeeding among mothers.⁴⁵ Breastfeeding has been shown to carry numerous immunological and protective health benefits for infants, but rates of the practice are persistently lower among low-income women and black mothers.⁴⁶ Of the five prior evaluations of HFA and NFP that examined effects on breastfeeding initiation, two have found promising results, with statistically significantly higher initiation rates observed among women in the program group than women in the control group.⁴⁷

The two models also aim to improve child health by promoting health-related parenting practices and encouraging the use of preventive care, such as maintaining well-child visits and ensuring that children receive immunizations and assessments of their growth and development. Greater use of preventive care could reduce the need for treatment of acute conditions in high-cost settings such as emergency departments (EDs) and hospitals. At the same time, home visitors could encourage families to seek *more* care for their children in either high- or low-cost settings by raising their awareness of health concerns or available health services.

Compared with prenatal health behaviors, the use of infant health care has been a more commonly examined outcome in the home visiting literature. The prior evidence of improvements in this area is mixed. Only one out of five HFA and NFP studies to examine impacts on the frequency of preventive care use in the first two years found a statistically significant difference in the number of well-child visits, with more visits among the program group than among the control group.⁴⁸ Two earlier HFA studies examining whether infants visited the ED in the first two years did not find statistically significant

⁴⁵Filene et al. (2013).

⁴⁶Ryan, Wenjun, and Acosta (2002).

⁴⁷LeCroy and Davis (2017); Green et al. (2014); Kitzman et al. (1997); Mitchell-Herzfeld et al. (2005). Miller (2015) notes that the NFP Elmira trial (Olds, Henderson, Tatelbaum, and Chamberlin, 1986) also collected data on breastfeeding initiation rates, and no statistically significant program effects were found on this outcome. Studies examining the duration of breastfeeding have found no differences between research groups in the length of time for which women continued to breastfeed their infants (Kitzman et al., 1997; Mitchell-Herzfeld et al., 2005; Green et al., 2014).

⁴⁸Green, Tarte, Sanders, and Waller (2016); Kitzman et al. (1997); Landsverk et al. (2002); LeCroy and Davis (2017); Mitchell-Herzfeld et al. (2005). Two additional RCTs of HFA examined whether children received an adequate number of well-child visits in the first two years of life (Caldera et al., 2007; Duggan et al., 1999). Neither study found differences between the program and control groups using this outcome measure.

differences,⁴⁹ although an NFP study found that home visiting reduced the average number of ED visits in both the first and second years of life.⁵⁰ The prior evidence on whether home visiting reduced infant hospitalizations in the first or second year of life is limited to two investigations, neither of which found impacts.⁵¹

Differences in Effects for Different Families

Many studies of evidence-based home visiting models have included too few families to allow for a robust analysis of whether effects vary for different subgroups of families. Yet, as the prior discussion suggests, whether home visiting is more effective for some women than for others is an important question in a study of birth outcomes. Certain groups, such as some racial minorities, smokers, and teenage mothers, are at significantly higher risk than others in this domain. Even among women of low socioeconomic status, for example, there are persistent black-white disparities in birth outcomes.⁵² In contrast, some groups of Hispanic women, primarily those of Mexican or Mexican-American descent, fare better on birth outcomes despite also having lower socioeconomic status profiles.⁵³ As noted earlier, the evidence from a prior study suggested that NFP was most effective at reducing preterm birth for very young mothers and smokers.⁵⁴ But the sample sizes for both subgroups in that study were very small (consisting of 45 very young mothers and 142 smokers).⁵⁵ The study looking at the impacts of HFA on low birth weight in New York found that the reduction in low birth weight was particularly pronounced for African-American mothers, but this result has not been found in other studies.⁵⁶ Thus, there is reason to investigate further how program impacts may differ among particular groups of low-income mothers.

⁴⁹Duggan et al. (1999); Caldera et al. (2007).

⁵⁰Olds, Henderson, Chamberlin, and Tatelbaum (1986). In addition to the NFP trial referenced, two trials of HFA have examined whether home visiting reduced the frequency of ED visits (Green, Tarte, Sanders, and Waller, 2016; Mitchell-Herzfeld et al., 2005). Neither study found statistically significant differences between research groups.

⁵¹Duggan et al. (1999); Caldera et al. (2007).

⁵²Braveman et al. (2015); Lu and Halfon (2003); Lu et al. (2010). The differences in socioeconomic status across racial groups have not been able to fully explain these black-white disparities.

⁵³McGlade, Saha, and Dahlstrom (2004); Scribner (1996).

⁵⁴Olds, Henderson, Tatelbaum, and Chamberlin (1986).

⁵⁵Olds, Henderson, Tatelbaum, and Chamberlin (1986).

⁵⁶Lee et al. (2009).

The Role of Program Implementation

Prior studies of human service programs, including home visiting, have found that program effects are associated with a number of implementation-related factors. Implementation factors are linked in theory to program effects; for example, a program's goals may change the likelihood that a home visitor delivers services related to a particular outcome, which, in turn, affects how the program may influence that outcome.⁵⁷ And there is some empirical evidence of this relationship as well. For example, a meta-analysis of early childhood home visiting studies found that programs that listed the prevention of child abuse as a primary goal were more likely to improve that outcome than programs that did not state child abuse prevention as a core goal.⁵⁸ Another meta-analysis found that program impacts on outcomes were greater when initial home visitor training included role-play and supervision was reflective than when the training only addressed administrative issues or case management.⁵⁹

Despite the programmatic importance of understanding *how* program impacts are or are not achieved, there has been limited systematic documentation of program implementation in studies of home visiting programs in general⁶⁰ and in studies of home visiting and birth outcomes in particular.⁶¹ At most, studies tend to report dosage, as captured by the number of home visits received or the duration of participation.⁶² Earlier research from HFA and NFP suggested that many families leave programs earlier and receive fewer visits than intended by evidence-based model developers.⁶³

Service Plans of HFA and NFP

The gaps in our understanding of home visiting implementation are particularly important to address because home visiting is largely a decentralized service strategy, which could lead to wide variation in implementation across locations. As summarized in Table 1.1, the two models included in MIHOPE-Strong Start are similar in many ways

⁵⁷Sweet and Appelbaum (2004).

⁵⁸Sweet and Appelbaum (2004).

⁵⁹Casillas, Fauchier, Derkash, and Garrido (2016).

⁶⁰Paulsell, Del Grosso, and Supplee (2014).

⁶¹Issel et al. (2011).

⁶²Paulsell, Del Grosso, and Supplee (2014).

⁶³Boller et al. (2014); Duggan et al. (2007); Duggan et al. (2015); O'Brien et al. (2012).

but also different in others — including in their origins and goals, staffing requirements, specific target populations, and intended service delivery.⁶⁴

As Table 1.1 makes clear, NFP had standardized particular aspects of its model more than HFA. In terms of the model requirements, NFP began home visiting services with women early in their pregnancy, while HFA programs enrolled women at any time during pregnancy and up until a few months after birth. (Although the local HFA programs included in MIHOPE-Strong Start were selected because they enrolled a high number of pregnant women, only women who were no more than 32 weeks pregnant were eligible for the study.)⁶⁵ However, both models allowed for some local flexibility in various aspects of implementation. For example, both provided model-specific continuing education for home visitors, supervisors, and administrators while also encouraging local programs to provide professional development opportunities tailored to meet the needs of their community and the home visiting staff.

A final consideration for understanding implementation is that home visiting is a voluntary program for families, so home visitors often need to balance the goal of keeping families engaged in services with addressing complex and sometimes very sensitive risks.⁶⁶ These goals are not always easy to integrate. Multiple factors — including the characteristics of families, home visitors, and local programs — could influence the intensity and content of services delivered to individual families, but often there is little information collected across the range of these factors, which limits the understanding of their relative roles in shaping service delivery.

Overview of MIHOPE-Strong Start’s Design

To address the importance of learning more about both the implementation of home visiting programs and their potential effects on prenatal, birth, and infant health outcomes, MIHOPE-Strong Start includes:

⁶⁴Filene et al. (2013). While neither of the models made significant changes to their planned services during the MIHOPE-Strong Start study period, evidence-based models regularly use findings from current research and their own data to update their planned services, details of their protocols, and guidance to local programs about programmatic expectations.

⁶⁵Though HFA usually also allows enrollment of mothers up to three months after a child is born, families were not included in this study if the mother was more than 32 weeks pregnant. As described further in Chapter 2, local HFA programs that primarily serve women who have already given birth were not recruited for the study.

⁶⁶Duggan et al. (2018); Tandon, Mercer, Saylor, and Duggan (2008).

Table 1.1

Summary of Healthy Families America and Nurse-Family Partnership

Characteristic of Model	Healthy Families America (HFA)	Nurse-Family Partnership (NFP)
Program origins and goals	<p>To promote child well-being and prevent child abuse and neglect by:</p> <ul style="list-style-type: none"> • Helping to establish and sustain community partners to systematically engage overburdened families in home visiting services prenatally or at birth • Cultivating and strengthening nurturing parent-child relationships • Promoting healthy childhood growth and development • Enhancing family functioning by reducing risk and building protective factors • Preventing child maltreatment and adverse experiences 	<p>To empower first-time mothers living in poverty to change their and their children's lives by:</p> <ul style="list-style-type: none"> • Improving pregnancy outcomes by helping women to obtain prenatal care, improve their diets, and reduce their use of potentially harmful substances • Improving child health and development by helping parents provide responsible and competent care • Improving families' economic self-sufficiency by helping them to develop a vision for their own future, plan future pregnancies, and continue their education and find work
Intended recipients (or target population)	<ul style="list-style-type: none"> • Families with risk factors for child maltreatment or other negative child outcomes • Families enroll prenatally or within the first three months after a child's birth 	<ul style="list-style-type: none"> • First-time, low-income pregnant women • Families receive their first home visit no later than the end of week 28 of pregnancy^a
Duration and intensity of services for a typical family^b	<ul style="list-style-type: none"> • Weekly or biweekly visits during pregnancy • Visits ranging from weekly to quarterly through the child's third birthday (though visits can extend to the child's fifth birthday)^c 	<ul style="list-style-type: none"> • Weekly or biweekly visits during pregnancy • Visits ranging from weekly to monthly through child's second birthday^d
Intended staffing	<ul style="list-style-type: none"> • Recommends selecting home visitors based on a combination of personal characteristics (such as being nonjudgmental and compassionate, having experience working with families, or having child development or educational qualifications) 	<ul style="list-style-type: none"> • Requires home visitors to be baccalaureate-prepared registered nurses • Requires programs to submit a formal variance to get approval for employing staff who do not meet the staff qualification standards
Flexibility toward intended recipients, services, and implementation	<ul style="list-style-type: none"> • Requires implementing agencies to adhere to a comprehensive set of model standards, with flexibility afforded in the areas of target population, staffing, and parenting materials used in order to meet the needs of families in each community 	<ul style="list-style-type: none"> • Has a defined approach, with flexibility of visit, content, and frequency based on the clients' strengths, risks, and needs • Expects local programs to strive for fidelity to the model as it has been defined at the national level

SOURCE: Adapted from the MIHOPE-Strong Start first annual report (Filene et al., 2013).

NOTES: ^aLocal programs were recommended to begin conducting visits as early as possible in the pregnancy.

^bVisit schedules could be adjusted based on family's risk level and need.

^cVisits scheduled weekly during first six months after child's birth. Subsequent visit schedule depends on progress of the family: level 1 = weekly; level 2 = every other week; level 3 = monthly; level 4 = quarterly.

^dNFP introduced the Strength and Risk (STAR) framework in 2015. Using the STAR framework, after pregnancy, the frequency of visits may change based on the assessment of the client's strengths and risks.

- An **implementation analysis** describing how local programs were structured and implemented; the quantity and types of services provided to women assigned to the program group; and patterns in service delivery by family, home visitor, and local program characteristics.
- An **impact analysis** estimating the effects of home visiting on prenatal health, birth outcomes, and the use of health care services in the year after birth. In addition, an impact variation analysis links the implementation analysis to the impact analysis by examining the relationships between family characteristics, local program features, and impacts observed across programs.

Women were eligible for MIHOPE-Strong Start if they were no more than 32 weeks pregnant, were age 15 or older, spoke English or Spanish with enough proficiency to provide informed consent, and were eligible and interested in receiving home visiting services. To provide unbiased estimates of the effects of home visiting programs, families recruited into the study were randomly assigned either to a program group that could receive home visiting services from a local HFA or NFP program or to a control group whose members were given information on other services available in the community. Studies such as MIHOPE-Strong Start that use random assignment are designed so that the program and control groups are similar in all respects when they enter the study. As is standard in random assignment studies, the primary analytical strategy is to compare the outcomes for the program group with those of the control group. Differences that emerge after random assignment can then be reliably attributed to the program group's access to the intervention.

For MIHOPE-Strong Start, random assignment of families occurred after a home visiting program determined that a woman was eligible and interested in the program but before she enrolled in it. This was done to minimize the number of women assigned to the program group who subsequently did not receive home visiting services. Nonetheless, some program group families might receive no home visits and some control group families might receive similar services, so the effects on outcomes in MIHOPE-Strong Start depend on the extent to which program group and control group families received different amounts of home visiting services. Information about the home visiting services received by program group families is discussed in Chapter 3.

As described in an earlier report, the initial goal of the study was to recruit 15,000 families across 100 local HFA or NFP programs.⁶⁷ This ambitious goal was based in

⁶⁷Lee, Crowne, Faucetta, and Hughes (2016).

part on the relative rarity of the birth outcomes of interest and in part on actuarial calculations of the sample size needed to detect reductions in Medicaid costs due to improved birth outcomes. However, it soon became clear that recruiting such a large sample of programs and families in the time frame of the study would not be possible. For the study to achieve the initial targeted number of families, almost every eligible program approached by the recruitment team would have had to agree to participate in MIHOPE-Strong Start and complete all phases of the recruitment process. Upon conducting further analyses, the study team projected that a sample size of about 3,400 families from 75 local programs was realistic to obtain and would still allow for examination of the study's key questions of interest. Although the study's goals and planned analyses did not change, reducing the sample reduced the confidence with which the study can detect effects on relatively rare outcomes, such as birth outcomes.

Though falling short of the initial recruitment goals, MIHOPE-Strong Start analyzes information from a final sample of 2,900 families across 66 local home visiting programs in 17 states. These final sample size numbers are close to the revised projected targets of 3,400 families and 75 programs. While MIHOPE-Strong Start includes a large number of families and local programs, it is important to keep in mind that the sample is not necessarily representative of all HFA and NFP programs or families served by these programs.

While MIHOPE-Strong Start is examining the relationship between home visiting and birth outcomes among HFA and NFP programs, a separate study called the Mother and Infant Home Visiting Program Evaluation (MIHOPE) represents a broader investigation of evidence-based home visiting's implementation and effectiveness.⁶⁸ MIHOPE is the legislatively mandated evaluation of the Maternal, Infant, and Early Childhood Home Visiting (MIECHV) program and provides a more comprehensive examination of effects by assessing a range of outcome domains beyond those examined in MIHOPE-Strong Start.⁶⁹ These include parenting practices, child development, child maltreatment, intimate partner violence, economic self-sufficiency, and maternal and child health

⁶⁸MDRC is also leading MIHOPE, in partnership with James Bell Associates, Johns Hopkins University, Mathematica Policy Research, the University of Georgia, and Columbia University.

⁶⁹In 2010, Congress authorized the MIECHV program by enacting section 511 of the Social Security Act, 42 U.S.C. § 711, which also appropriated funding for fiscal years 2010 through 2014 (§ 511[42 U.S.C. 711](j)(1)). Subsequently enacted laws extended funding for the program through fiscal year 2022; specifically, section 209 of the Protecting Access to Medicare Act of 2014, Pub. L. 113-93 (fiscal year 2015); section 218 of the Medicare Access and Children's Health Insurance Program Reauthorization Act of 2015, Pub. L. 114-10 (fiscal years 2016-2017); and section 50601 of the Bipartisan Budget Act of 2018, Pub. L. 115-123 (fiscal years 2018-2022). For more information about the

(but not prenatal health or birth outcomes). In addition to HFA and NFP, MIHOPE includes two other widely used evidence-based models: Early Head Start — Home-based option (EHS) and Parents as Teachers (PAT). Findings from MIHOPE, including implementation, impact, and cost analyses, are also being published and made available on the OPRE and MDRC websites.⁷⁰

Despite the differing lenses of MIHOPE and MIHOPE-Strong Start, there is a significant overlap between the programs and the individuals identified as eligible for each study. In fact, all HFA and NFP programs that were eligible for MIHOPE were also eligible for MIHOPE-Strong Start because they operated according to the framework of the evidence-based model regardless of whether they received MIECHV funding. Many of the local programs (nearly 90 percent) in MIHOPE-Strong Start, including the 48 programs recruited through MIHOPE, received MIECHV funding at study entry. A subset of the individuals enrolled in MIHOPE — those who were no more than 32 weeks pregnant and who enrolled in the study through an HFA or NFP program — met the eligibility criteria for MIHOPE-Strong Start, too. This report therefore combines the information from the sample enrolled in MIHOPE-Strong Start and the sample enrolled in MIHOPE who met the eligibility criteria for MIHOPE-Strong Start.

Further detail on the distinctions and overlap between the two studies is provided in Figure 1.1. The final sample analyzed in this report includes families enrolled in 18 HFA or NFP programs who were recruited specifically for MIHOPE-Strong Start as well as families from 48 HFA or NFP programs participating in MIHOPE.

Overview of Potential Effects

While the previous summary makes clear that the prior evidence has been limited, the persistence of socioeconomic disparities in birth outcomes and their substantial implications warranted a new test of whether evidence-based home visiting programs could improve newborn health.

MIHOPE-Strong Start assessed the effects of local home visiting programs on several key outcome areas that were rated as moderately high or high priority by the two

MIECHV program, see <https://mchb.hrsa.gov/maternal-child-health-initiatives/home-visiting-overview> and www.acf.hhs.gov/ecd/home-visiting/tribal-home-visiting.

⁷⁰See www.acf.hhs.gov/opre/research/project/maternal-infant-and-early-childhood-home-visiting-evaluation-mihope or www.mdrc.org/project/mother-and-infant-home-visiting-program-evaluation-mihope.

Figure 1.1

**Two Studies of the Effects of Evidence-Based Home Visiting:
MIHOPE-Strong Start and MIHOPE**

	MIHOPE-Strong Start Mother and Infant Home Visiting Program Evaluation - Strong Start	MIHOPE Mother and Infant Home Visiting Program Evaluation
Policy context	Part of the Center for Medicare and Medicaid Innovation's Strong Start for Mothers and Newborns Initiative	Legislatively mandated evaluation of the Maternal, Infant, and Early Childhood Home Visiting program
Evidence-based models	Healthy Families America Nurse-Family Partnership	Early Head Start—Home-based option Healthy Families America Nurse-Family Partnership Parents as Teachers
Targeted sample	Pregnant women in the first 32 weeks of their pregnancies. Recruited from local programs that served primarily Medicaid beneficiaries.	Pregnant women or families with a child less than 6 months of age
Focuses of the impact analysis	<ul style="list-style-type: none"> • Maternal and child health <ul style="list-style-type: none"> —Prenatal health —Birth outcomes —Infant health care 	<ul style="list-style-type: none"> • Maternal and child health • Child development • Parenting and home environment • Child maltreatment • Intimate partner violence • Economic self-sufficiency
Scope and size of the study	17 states, 66 MIECHV and non-MIECHV-funded local programs, and 2,900 families	12 states, 88 MIECHV-funded local programs, and 4,229 families

evidence-based models.⁷¹ These outcome areas were also identified in the two evidence-based model developers' logic models as goals that their programs are designed

⁷¹As described in Filene et al. (2013), in information provided to the study team, both HFA and NFP rated birth outcomes as very high priority (9 or 10 on a scale from 0 to 10). Other areas of focus that both evidence-based models rated high priority are tobacco use during pregnancy, child preventive care, and breastfeeding. HFA rated prenatal health and maternal postnatal physical health as moderately high priority (7 on a scale from 0 to 10) and NFP rated these areas as very high priority (10 on a scale of 10).

to improve.⁷² Following the terminology used by the Institute for Education Sciences (IES) at the U.S. Department of Education, these outcomes are called “confirmatory” and were prespecified and selected based on a review of prior evidence, policy relevance, and measurement quality.⁷³ Other outcomes considered “exploratory,” as well as exploratory subgroups, were also prespecified.⁷⁴ For these, the prior empirical evidence and theoretical links between home visiting and impacts were less clear. The confirmatory outcomes and exploratory outcomes are summarized in the following sections by domain.

Prenatal Health

Confirmatory outcomes. There is one confirmatory outcome within the domain of prenatal health, which is:

- Whether the mother smoked during the third trimester

Smoking plays a significant role in compromised birth outcomes, and, as described earlier, prior evidence from two NFP evaluations suggests that home visiting programs could reduce smoking among women who receive services.⁷⁵ Because women in the study enrolled primarily within the first or second trimester, the impact analysis focuses on smoking in the last trimester. It was hypothesized that program group women would exhibit lower smoking rates during the latter phase of pregnancy than control group women.

Exploratory outcomes. Exploratory outcomes of prenatal health consist of other indicators of health behaviors as well as health care use and coverage in Medicaid during pregnancy, including:

- The number of cigarettes smoked per day during the third trimester

⁷²This statement is based on a review of HFA’s and NFP’s logic models, which both model developers provided to the study team shortly after the study began, along with other documentation about their core model elements.

⁷³Schochet (2008). Over the past few years, evaluation methodologists have begun to recommend focusing impact studies on a more limited set of outcomes to reduce the chances of a “false positive” finding in which an intervention with no true effect produces statistically significant impacts on at least one outcome. IES calls this set of outcomes “confirmatory outcomes.”

⁷⁴Study team memos submitted to the U.S. Department of Health and Human Services before the impact analysis was begun outlined the rationale for and specification of confirmatory and exploratory outcomes as well as of exploratory subgroups.

⁷⁵Olds, Henderson, Tatelbaum, and Chamberlin (1986); Olds et al. (2002).

- Whether mothers who smoked prior to pregnancy or in the first trimester stopped by the third trimester
- Whether the mother's gestational weight gain fell within the range recommended by the Institute of Medicine⁷⁶
- Whether the mother received adequate prenatal care
- Whether the mother had any Medicaid-paid ED visits during pregnancy
- The number of Medicaid-paid ED visits during pregnancy
- Whether the mother had any Medicaid-paid hospitalizations during pregnancy
- Whether the mother was ever enrolled in Medicaid during the prenatal period
- Whether the mother was fully or partially enrolled in Medicaid during the prenatal period
- The proportion of the prenatal period for which the mother was covered by Medicaid

Birth Outcomes and Other Related Care

Confirmatory outcomes. There are three confirmatory outcomes that indicate health status at birth:

- Whether the infant was born at a low birth weight (at less than 2,500 grams)
- Whether the infant was born preterm (at less than 37 weeks into the pregnancy)
- Whether the infant was admitted to the neonatal intensive care unit (NICU)

Low birth weight and preterm birth have been examined in prior trials of HFA and NFP and are widely used indicators of newborn health. As noted earlier, one study of HFA found significant reductions in the incidence of low birth weight for women in the

⁷⁶Rasmussen, Catalano, and Yaktine (2009).

program group,⁷⁷ and one study of NFP found significant reductions in preterm birth.⁷⁸ In addition, another study of NFP found significant reductions in preterm birth for particular subgroups of families, including smokers and very young mothers.⁷⁹ Home visiting was hypothesized to reduce the prevalence of these outcomes. Admission to the NICU is also a confirmatory outcome, given its close connection to low birth weight and prematurity and the high health care costs of NICU admission. However, this outcome has seldom been examined in the prior literature on HFA and NFP; the one HFA study that has examined rates of NICU admission did not find any effects.⁸⁰

Exploratory outcomes. Exploratory outcomes of newborn health include the following other indicators of birth weight and gestational age:

- Birth weight in grams
- Whether the infant had a very low birth weight (less than 1,500 grams)
- Whether the infant had a high birth weight (more than 4,000 grams)
- Obstetric estimate of gestation (weeks completed)
- Whether the infant was born early (less than 39 weeks into the pregnancy)
- Whether the infant was born very preterm (less than 32 weeks into the pregnancy)
- Whether the infant was small for gestational age (below the tenth percentile)
- Whether the infant was large for gestational age (above the ninetieth percentile)

Health care events occurring at the time of delivery are also considered exploratory outcomes in this domain. These include:

- The number of days the infant spent in the NICU

⁷⁷Lee et al. (2009).

⁷⁸Estimates of statistical significance are based on further calculations of the data from Nguyen, Carson, Parris, and Place (2003) by Miller (2015).

⁷⁹Olds, Henderson, Tatelbaum, and Chamberlin (1986).

⁸⁰Mitchell-Herzfeld et al. (2005).

- Whether the infant had a Medicaid-paid hospitalization at birth and the number of days the infant was hospitalized at birth
- Whether the mother had a Cesarean delivery
- Whether first-time mothers who gave birth to a singleton, nonbreach baby had a Cesarean delivery
- The number of days a mother was hospitalized at delivery

Breastfeeding Initiation

Confirmatory outcomes. Given the prioritization of breastfeeding among the evidence-based models and its recognition as a protective health practice, the study includes as a confirmatory outcome:

- Whether the mother was breastfeeding at discharge from the birth hospital

As described earlier in the chapter, one prior HFA evaluation and one prior NFP evaluation both found promising results on this outcome, with statistically significantly higher breastfeeding initiation rates observed among women in the program group than among women in the control group.⁸¹

Infant Health Care Use

Confirmatory outcomes. The three confirmatory outcomes for infant health care use (from birth until the first year) include:

- The number of Medicaid-paid well-child visits
- Whether the infant had at least one Medicaid-paid ED visit
- Whether the infant had at least one Medicaid-paid hospitalization

As an indicator of preventive care, receipt of well-child visits is among the more commonly examined outcomes in prior HFA and NFP studies, with one prior study of HFA finding statistically significantly higher numbers of well-child visits among program group families in the child's second year of life.⁸² Home visitors' encouragement of families to take their infants for their recommended checkups was theorized to increase the receipt of well-child visits. As noted earlier, the evidence of the effects of home visiting

⁸¹LeCroy and Davis (2017); Kitzman et al. (1997).

⁸²Landsverk et al. (2002).

on ED use is mixed and on hospital admissions during infancy is somewhat limited. Two earlier studies of HFA examined whether the infant ever used the ED during the first two years and neither found effects;⁸³ these same two HFA evaluations also looked at the outcome of nonbirth hospitalizations and found no effects.⁸⁴ Theoretically, improved birth outcomes and home visitors' encouragement of preventive care could lead to fewer health care needs being addressed in an ED or hospital. On the other hand, home visiting could raise parental awareness of emergent health concerns or available health services, leading to a higher use of EDs and hospitalizations. These outcomes are included as confirmatory because they are both costly settings in which to receive care, and for hospitalizations in particular, they are indicative of a serious health event or concern.

Exploratory outcomes. Outcomes considered exploratory include the following additional measures of Medicaid-paid health care use in the year following birth for both infants and mothers as well as Medicaid coverage indicators:

- The number of infant ED visits
- The number and length of infant hospitalizations
- Compliance with the recommended number of well-child visits
- Receipt and number of immunization shots for the infant
- Whether the mother received a postpartum visit
- Receipt and number of maternal ED visits in the year after birth
- Whether the infant was fully or partially enrolled in Medicaid, and the proportion of days enrolled
- Whether the mother was fully or partially enrolled in Medicaid, and the proportion of days enrolled

⁸³As described earlier in this chapter, one NFP study found that home visiting reduced the average number of ED visits in both the first and second year of life (Olds, Henderson, Chamberlin, and Tatelbaum, 1986).

⁸⁴Duggan et al. (1999); Caldera et al. (2007).

Data Sources

To assess home visiting programs' effects across several health-related domains and to document features of program implementation, the study relies on multiple data sources. An overview of these data sources is provided in Box 1.1. They include:

- survey data about local programs, staff members, and families that were collected from staff members and families, providing baseline information about sociodemographic characteristics and information about the goals and implementation of the local programs and evidence-based models;
- management information system (MIS) and service delivery log data from local programs, used to assess the quantity of services delivered (or “dosage”) and types of services provided;
- information on community characteristics from the U.S. Census and HRSA; and
- administrative vital statistics records and Medicaid enrollment and claims data, used to measure outcomes during pregnancy, at birth, and over the first year.

More details on data sources and analysis samples are provided in Appendix A.

A timeline for the study's key data collection activities is shown in Figure 1.2. It includes data collection activities for MIHOPE-Strong Start and information collected for the MIHOPE programs and families included in this report's analysis. From October 2012 to October 2015, information was collected from local programs and home visitors. Families were recruited into the study and randomly assigned from October 2012 to September 2015. The study team also negotiated administrative-data-sharing agreements over a period of several years,⁸⁵ with the final data received in 2017.

⁸⁵Lee, Warren, and Gill (2015).

Box 1.1

Data Sources

MIHOPE-Strong Start combines information from various sources for both the implementation analysis and the impact analysis. These sources are summarized below:

- **Family characteristics at baseline:** Family surveys of expectant mothers at the time of study entry provide data on 2,875 women, 1,556 of whom were randomly assigned to the program group and 1,319 of whom were assigned to the control group.* Information from study intake files and vital records was used when possible for the 25 women who did not complete a baseline interview. Interviews were completed between October 2012 and September 2015.
- **Home visitor characteristics:** Staff surveys of 393 home visitors provide data on their sociodemographic characteristics; their reports of access to and use of clinical and administrative sources of support; and their perceptions, attitudes, and beliefs regarding their work. Surveys were completed between October 2012 and October 2015.
- **Local programs:** Staff surveys of program managers at 66 local programs provide data on the key characteristics of the programs, such as service plan elements, policies and protocols, the presence and types of implementation system support tools, and networks of referral agencies. Surveys were completed between October 2012 and August 2015.
- **Evidence-based model developer information:** Surveys, interviews, and document reviews from the Healthy Families America (HFA) and Nurse-Family Partnership (NFP) model developers provide information on the service plans and implementation systems. Interviews with model developers were completed between December 2012 and August 2013. Supplemental interviews occurred in June 2017.
- **Community characteristics of families:** Census tract data for 2014 from the American Community Survey's five-year estimates provide sociodemographic characteristics of communities based on geocoded home addresses at baseline for 2,860 families. Health care environment data about the Primary Care Service Areas in which 2,893 families resided at baseline come from the 2010 American Medical Association primary care physician data and the 2012 HRSA Data Warehouse and provide information on the prevalence of primary care physicians and Federally Qualified Health Center sites.
- **Home visiting services for individual families:** Family service logs, completed weekly by the home visitors for the 841 program group families in MIHOPE who were eligible for MIHOPE-Strong Start, provide information on the frequency and duration of home visits with the family, topics discussed, and referrals provided.

(continued)

Box 1.1 (continued)

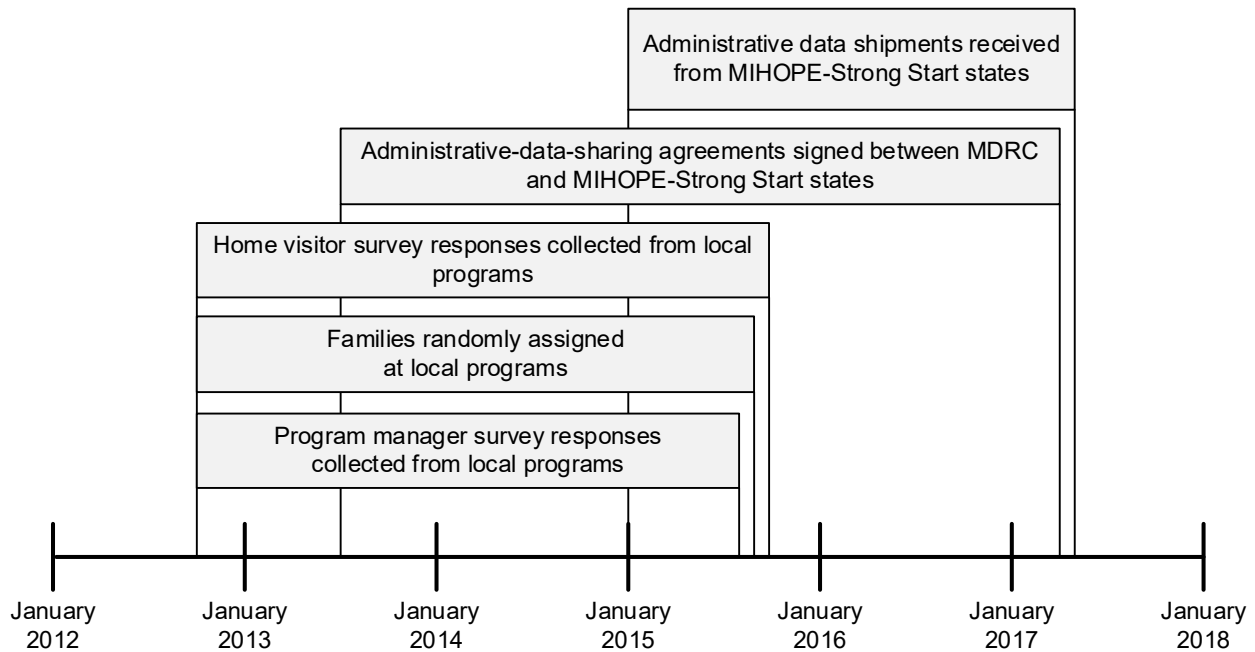
Family service logs were completed between November 2012 and July 2016. Management information system (MIS) data provide information on the 500 program group families who were recruited through MIHOPE-Strong Start. The data are largely parallel to the types of information included in the family service logs collected as part of MIHOPE. MIS data span June 2014 through December 2016.

- **Birth outcomes and maternal health behaviors:** Birth certificate and fetal death records from 17 states provide information about the health of the baby at birth, the mother's behaviors during pregnancy, and breastfeeding at the time of discharge from the hospital. The birth certificate also contains information on exploratory outcomes, including adequate prenatal care, Cesarean sections, and family baseline measures, such as the mother's level of education and parity of birth. Vital records are available for 2,609 mothers and 2,650 infants in the study for births that occurred from December 2012 through April 2016.
- **Medicaid enrollment and use of health care:** Medicaid enrollment and use data from 17 states provide information on maternal and infant Medicaid-paid health care use and coverage from January 2011 to May 2017. These data include fee-for-service claims and managed care encounters, depending on the health care system in the state. They also provide follow-up data on Medicaid coverage and use for the mother and infant at birth, such as the length of the hospital stay and NICU admissions, as well as in the first year, including emergency department visits and well-child office visits. The sample included in Medicaid-derived outcomes consists of 2,896 mothers and 2,790 infants.

*Overall, about 54 percent of the sample analyzed in this report were randomly assigned to the program group and 46 percent were assigned to the control group. MIHOPE-Strong Start used a random assignment ratio of 60 percent of families assigned to the program group and 40 percent of families assigned to the control group; for sample members recruited through MIHOPE, half were assigned to the program group.

Figure 1.2

MIHOPE-Strong Start Timeline of Key Study Activities



NOTE: This timeline covers data collection for local programs and families who were recruited in MIHOPE, which began in October 2012, and met the MIHOPE-Strong Start eligibility criteria, as well as those recruited in MIHOPE-Strong Start, which began in June 2014. Administrative data refers to Medicaid and vital records.

Questions Addressed in This Report

This final report from MIHOPE-Strong Start addresses the following questions:

- **What are the characteristics of local home visiting programs and families that were included in MIHOPE-Strong Start?** This question is discussed in Chapter 2, which describes how local programs and families were recruited and presents information on selected characteristics of the sample at study entry.
- **How focused were home visiting staff members on improving prenatal and birth outcomes, and in what ways were they supported by their programs in addressing risk factors for poor birth and health outcomes? What services did families receive? How did**

service delivery vary across families, and what factors seemed to influence the variation in services? These questions are examined in Chapter 3, which describes the implementation of home visiting programs.

- **What effects did home visiting programs have on improving prenatal health, reducing low birth weight and preterm birth, and altering infant health care use? How did the effects for families vary with family risk factors and across local programs?** These questions are addressed in Chapter 4, which presents impact analysis results.
- **What are the implications of the study findings?** These questions are discussed in the conclusion, Chapter 5.

Chapter 2

Recruitment and Characteristics of the Sample

This chapter summarizes the recruitment process for local home visiting programs and families included in the Mother and Infant Home Visiting Program Evaluation-Strong Start (MIHOPE-Strong Start) analysis, a process that began in 2012 and ended in 2015. It also describes the characteristics of the local programs, local staff members, and families when the study began.

Findings in Brief

- **Local programs in MIHOPE-Strong Start were well established, were large, and delivered services in primarily urban areas.** The majority of local programs had the capacity to serve more than 100 families and most had been in operation for six or more years.
- **The home visitors working in the programs were diverse in their sociodemographic characteristics and experience.** Home visitors' ages ranged from under 20 to over 60 years old, with about half of all home visitors being between 30 and 49. Additionally, about half were non-Hispanic white, while the other half were mostly either non-Hispanic black or Hispanic. Three-fourths of home visitors had at least a bachelor's degree and about half of them had less than three years of experience in providing home visiting services.
- **Families in the study resided in communities with greater socioeconomic disadvantage on certain profile characteristics than the national average and than the average in urban areas in the 17 study states.** Rates of family poverty, families on public assistance, and unemployment were higher in the sample members' communities than elsewhere. These community-level profiles are indicative of the disadvantaged populations targeted by local programs.
- **Most women were covered by Medicaid at the time they entered the study and had received at least some prenatal care.** Specifically, 86 percent of women were enrolled in Medicaid and 83 percent reported having a usual source of prenatal care. Among the women who were randomly assigned in the second or third trimester of their

pregnancy (1,823 women), nearly three-fourths had initiated prenatal care in the first trimester.

- **On some indicators, women in the sample had fairly positive health profiles.** Roughly 9 percent of the sample reported smoking at the time of study entry, a rate lower than that of comparable populations. Most women reported being in good-to-excellent health.
- **On other indicators of risk, women in the sample had characteristics that are associated with increased likelihood of poor birth outcomes.** Specifically, despite their positive health profiles, study participants were young and had low levels of education, and the majority were not residing with the biological father at the time of study entry. The prevalence of elevated symptoms of depression or anxiety was high, at 43 percent. Slightly more than half of the sample reported experiencing food insecurity in the year prior to study enrollment.

Overview of Local Program Recruitment and Family Selection

Before the recruitment of families into the study could begin, the study team needed to identify and work with local programs implementing either the Healthy Families America (HFA) or Nurse-Family Partnership (NFP) model that could be potential candidates for the study. Because MIHOPE-Strong Start relied on administrative data collected at the state level to measure outcomes, the study team first identified priority states, including those that were already participating in the Mother and Infant Home Visiting Program Evaluation (MIHOPE) and other states that could increase the geographic diversity of programs included in the study. From there, and through conversations with both the HFA and NFP model developers and state-level representatives of the models, the study team identified local programs that were potentially good candidates for the study.

To be considered for MIHOPE-Strong Start, local programs had to have been in operation for at least two years, be employing at least three full-time home visitors (to ensure adequate sample enrollment for each program), and be serving a prenatal client population mostly covered by Medicaid. Of the estimated 800 programs (consisting of approximately 580 HFA and 220 NFP programs) operating nationwide around the time program recruitment began in 2012, approximately 435 were eligible to participate in the study based on study criteria information provided to the team by the evidence-

based model developers. This pool of potentially eligible programs represented 44 percent of all HFA programs and 72 percent of all NFP programs nationwide.¹

In addition to these criteria, local programs had to be interested in participating and had to serve an area with more demand than their services could meet, in order to allow a control group to be created. The study team also sought to recruit local programs that were located in an environment without other comparable services. For recruitment in MIHOPE, the study sought to include all of the local programs funded by the Maternal, Infant, and Early Childhood Home Visiting (MIECHV) program that provided home visiting services from one of the four evidence-based models in the study.² Similarly, for MIHOPE-Strong Start, the team tried to identify and include all programs in the area that were providing services through HFA or NFP.³ The team ruled out programs that exhibited evidence of implementation problems (for example, unstable funding or a lack of connections to service providers for incoming referrals) since such problems might interfere with the local program's ability to participate in the study. To the extent possible, the study team selected local programs that would contribute to the diversity of families in the sample for the purpose of estimating effects for subgroups. Finally, local programs were not to be located in service areas where the families they served were likely to have received services under other parts of the Strong Start for Mothers and Newborns Initiative of the Center for Medicare and Medicaid Innovation (CMMI).⁴ Using these criteria means that the local programs analyzed in MIHOPE-Strong Start are not necessarily representative of all NFP and HFA programs nationally.

MIHOPE-Strong Start is ultimately informed by the analysis of data from 2,900 families (initially, 2,911 families were enrolled in the study, but 11 of them subsequently withdrew) and 66 local programs (37 HFA and 29 NFP programs) operating across 17 states.⁵ The states included in the study are California, Georgia, Illinois, Indiana, Iowa, Kansas, Massachusetts, Michigan, Nevada, New Jersey, New York, North Carolina,

¹Lee, Crowne, Faucetta, and Hughes (2016).

²As described in Chapter 1, the models in MIHOPE included Early Head Start — Home-based option and Parents as Teachers, in addition to HFA and NFP.

³In the "Service Contrast" subsection of Chapter 5, there is a discussion about which services were available in the communities for control group members and which were received.

⁴Other approaches being tested to improve birth outcomes for women enrolled in Medicaid under CMMI's Strong Start Initiative include enhanced prenatal care services in group settings, peer counselors at birth centers, and maternity care homes. See the Centers for Medicare and Medicaid Services website: <https://www.cms.gov>.

⁵Of these 66 local programs, 48 participated in MIHOPE but were included in the MIHOPE-Strong Start analysis because they enrolled women before the thirty-second week of pregnancy. Although these 48 local programs were partly funded through the MIECHV program, local programs recruited specifically for MIHOPE-Strong Start did not have to be receiving MIECHV program funds.

Pennsylvania, South Carolina, Tennessee, Washington, and Wisconsin (see Figure 2.1). The states represent all the major regions of the country (the Midwest and Plains, Mountain and West, Northeast, and South). The more populous states, including California, Illinois, New Jersey, and New York, tend to be the ones with more local home visiting programs in the analysis, although an exception is Iowa, which contributed significantly to the sample of HFA programs included in the study despite its relatively lower population size.

Random assignment of study participants occurred after a home visiting program determined that a woman was eligible for and interested in the program but before she enrolled in it. This approach was taken to minimize the number of women assigned to the program group who subsequently did not receive home visiting services, since the study's ability to detect the effects of home visiting is lessened if some families assigned to the program group receive no home visiting services. As noted in Chapter 1, women were eligible to participate in the evaluation if they were no more than 32 weeks pregnant, at least 15 years old, able to complete a short survey in either English or Spanish, and eligible for and interested in receiving home visiting services.

Families recruited for MIHOPE-Strong Start had a 60 percent chance of being assigned to the program group and 40 percent chance of being assigned to the control group. The analysis in this report also includes women who were recruited for MIHOPE and who met the MIHOPE-Strong Start eligibility criteria. Women recruited for MIHOPE had a 50 percent chance of being assigned to the control group. Overall, about 54 percent of sample members analyzed in this report were randomly assigned to the program group and 46 percent were assigned to the control group.

Characteristics of Communities

As part of understanding the context within which local programs were operating, it is important to understand the types of communities in which families potentially served by local programs resided. The characteristics of communities not only influence the types of families served but also how local programs operate, including their ability to connect families with surrounding resources.

In this study, the word *community* is used to refer to the neighborhoods where families in the program and control groups resided when they entered the study rather than to the local programs' service areas, which can be a much larger geographic area. Table 2.1 presents information on the community characteristics of families in

Table 2.1
Community Characteristics of MIHOPE-Strong Start Families

Community Characteristics	National Mean	Urban-Area Mean	MIHOPE-Strong Start Community Mean ^a
<u>Sociodemographics of census tract</u>			
Total number of persons living in census tract	5,311	5,297	4,696
Community density (persons per square land mile)	5,487	11,997	7,687
Neighborhood socioeconomic disadvantage index ^b	0.0	0.1	1.0
Families living in poverty (%)	12.3	12.5	22.2
Families receiving public assistance (%)	7.8	8.9	13.2
Unemployed in civilian labor force ^c (%)	9.5	10.4	13.9
Age 25 years and over and less than high school degree or equivalency (%)	14.1	15.2	23.6
Uninsurance among the nonelderly population ^d (%)	16.1	15.3	21.1
Sample size (number of census tracts)			1,693
<u>Health care resources in Primary Care</u>			
<u>Service Area (PCSA)</u>			
Number of primary care physicians per 10,000 persons	7.6	8.9	7.8
Community has low primary care physician supply ^e (%)	7.0	3.9	3.1
Number of Federally Qualified Health Center (FQHC) sites per 10,000 persons ^f	0.4	0.3	0.4
Number of FQHC sites per square land mile ^f	0.1	0.4	0.3
Sample size (number of PCSAs)			332

SOURCES: Calculations based on U.S. Census Bureau, 2014 American Community Survey five-year estimates; 2010 U.S. Census data; 2010 American Medical Association primary care physician data; and 2012 Health Resources and Services Administration (HRSA) Data Warehouse information on FQHC sites.

NOTES: See Appendix A for details about sample sizes and Appendix B for more information about the measures presented in this table.

The sociodemographic measures are at the census tract level and the health care resource measures are at the PCSA level. Nationally (in the 50 states and Washington, D.C.), there are 73,056 census tracts and 7,144 PCSAs. In this study, an urban area is defined as less than 10 percent "rural"; MIHOPE-Strong Start sample members, on average, resided in census tracts that were 90 percent urban at baseline. The "Urban-Area Mean" column includes only urban areas within the 17 MIHOPE-Strong Start states (23,296 census tracts and 1,313 PCSAs). The national means and urban-area means are weighted by the total population in the census tract or PCSA.

^aThe values under "MIHOPE-Strong Start Community Mean" express the average among the census tracts or PCSAs of MIHOPE-Strong Start sample members, weighted by the number of sample members in each tract or PCSA.

^bThe index was normed to the population-weighted national averages and has a mean of zero and a standard deviation of one. See Appendix B for more details.

^cUnemployment is measured among the population 16 years and older.

^dNonelderly population is defined as less than 65 years old.

^e"Low" supply is defined as having no more than one doctor per 3,500 residents, which is the traditional calculation for a Health Professional Shortage Area index.

^fFQHC sites include grant-funded FQHCs, Rural Health Clinics, and grant-funded FQHC Look-Alikes.

Community sociodemographic characteristics. Reflecting the study's concentration in nonrural areas, MIHOPE-Strong Start families lived in more densely populated areas on average than the national population. However, the communities they lived in were less densely populated on average than urban communities in the 17 participating states.

Compared with the national population or with urban areas overall in the 17 study states, families in MIHOPE-Strong Start resided in more disadvantaged communities. This is indicated by their higher average socioeconomic disadvantage index score (with scores greater than zero indicating higher disadvantage than the national norms), as shown in Table 2.1.⁷ This is also evident by comparing the characteristics of the families with the national averages on the individual measures that feed into the neighborhood socioeconomic disadvantage index. For example, the average neighborhood family poverty rate among MIHOPE-Strong Start families was about 22 percent; in contrast, the average family poverty rate was about 12 percent nationally and about 13 percent in the urban areas of the 17 states.

Health insurance and health care resources. Perhaps reflecting the higher poverty rates, families in the study resided in communities with lower rates of health insurance coverage than the national average and populations in urban areas in study states. However, they also lived in communities with levels of access to primary health care resources similar to the national average, as captured by the density of primary care physicians (PCPs) and the number of Federally Qualified Health Centers (FQHCs) per person.⁸ And, consistent with residing in urban areas, sample members tended to live in areas that had an adequate supply of PCPs and had more FQHCs per square land mile than the nation.⁹

⁷Turney and Harknett (2010). Socioeconomic disadvantage is defined by a standardized sum of four variables from the U.S. Census Bureau's 2014 American Community Survey five-year estimates: (1) the percentage of families who have lived in poverty in the past 12 months; (2) the percentage of families who have received public assistance in the past 12 months; (3) the percentage of the civilian labor force (ages 16 and older) who are unemployed; and (4) the percentage of individuals at least 25 years old without a high school degree or equivalency. The index was set to a norm with a mean of zero and standard deviation of one for the population-weighted national averages.

⁸The research team examined the density of specialized physicians included under the umbrella of primary care physicians, specifically obstetricians or gynecologists and pediatricians. The patterns observed were very similar to the PCP measures shown in Table 2.1, although the average numbers of specific physicians per population were lower across the board.

⁹Cunningham and Hadley (2004); Salsberg and Forte (2002). The ratio of at least 1 physician per 3,500 residents follows criteria of the Health Resources and Services Administration (HRSA) from Health Professional Shortage Area designations.

These characteristics suggest that MIHOPE-Strong Start families resided in areas that had similar, and in some cases better, health care resources compared with communities nationwide. However, they also lived in communities with lower rates of insurance coverage, which can signal a greater need for and strain on the health care safety net for both publicly insured and uninsured populations. That is, safety net facilities (such as FQHCs) provide primary care regardless of income and insurance status, offering services on a sliding-fee scale, and they tend to serve both Medicaid and uninsured individuals.¹⁰ It is also important to note that the measures of health care resources shown in Table 2.1 are only rough proxies of access to care. Other factors, such as access to and the infrastructure of transportation and the density of providers that accept Medicaid beneficiaries, are salient for understanding access dynamics, particularly among low-income populations.¹¹ Since this information is neither easily measured nor widely available across communities, the study was unable to include it.

Key Model Requirements for Intended Staffing and Recipients

The HFA and NFP models target similar groups of women — low-income pregnant mothers. However, whereas NFP enrolls *only* first-time, expectant mothers in the twenty-eighth week of pregnancy or earlier, HFA allows women to enroll throughout pregnancy and up until their third month postpartum. HFA also serves mothers with an older child.¹² Because of the focus on prenatal and birth outcomes in MIHOPE-Strong Start, women who enrolled in HFA had to be no more than 32 weeks pregnant to be considered for the study.¹³ In terms of triaging for specific risk factors, NFP does not recommend giving certain families priority over others, although some local programs did place a higher priority on serving specific subgroups of women.¹⁴ Local HFA programs, in contrast, had the flexibility to consider risk factors for child maltreatment or other negative child outcomes in determining families' eligibility and setting service priorities.¹⁵

Additionally, the models have differing requirements for their home visitors: NFP requires home visitors to have a minimum of a bachelor's degree in nursing to work for the program, while HFA requires home visitors to have a minimum of a high school diploma or equivalent, with a preference for those with an infant mental health

¹⁰Lee, Hill, and McConville (2012).

¹¹DeVoe et al. (2007); Syed, Gerber, and Sharp (2013).

¹²Filene et al. (2013).

¹³Filene et al. (2013).

¹⁴Lee, Crowne, Faucetta, and Hughes (2016).

¹⁵Lee, Crowne, Faucetta, and Hughes (2016).

endorsement. Some of the differences in characteristics among home visitors and sample members, described below, reflect the varying requirements of the model with which they are affiliated.

Characteristics of Home Visitors

Local programs primarily operated in large metropolitan areas, reflecting the predominantly urban residential context of families.¹⁶ While study eligibility criteria required local programs to have been in operation for a minimum of two years, most local programs had been running for six or more years. The majority of local programs were also large, with almost 70 percent reporting the capacity to serve more than 100 families, although this was more common for NFP (90 percent) than HFA programs (51 percent). Local programs in the study sample also had more full-time home visitors than the average HFA or NFP programs nationwide.¹⁷ About three-fourths of agencies implementing HFA were community-based organizations, whereas about half of NFP programs were housed within local health departments.

In addition to the operational characteristics of local programs described above, Table 2.2 presents information on key social and demographic characteristics of home visitors, overall and by evidence-based model, at the time of study entry. This information is based on the responses of 393 out of the 502 home visitors who had consented to respond to the survey (a 78 percent response rate). Some of the characteristics, such as education level, field of study, and work experience, may reflect home visitors' different skills and orientations in working with families, which could influence how effectively services are delivered.¹⁸

The home visitors in the study varied in age and racial and ethnic background. The age distribution of home visitors is wide, although it is in line with other studies documenting that home visitors tend to be less than 40 years old.¹⁹ HFA employees in the study tended to be somewhat younger than NFP home visitors; nearly 32 percent of

¹⁶Lee, Crowne, Faucetta, and Hughes (2016). The local program characteristics summarized in this section are shown in Appendix Table B.1.

¹⁷According to the *2017 Home Visiting Yearbook* (National Home Visiting Resource Center, 2017), the average number of full-time home visitors for HFA programs nationwide was five, compared with six among local programs participating in the MIHOPE-Strong Start study. For NFP, local programs in the MIHOPE-Strong Start study employed about nine full-time home visitors on average, compared with an average of seven among programs nationwide.

¹⁸Wasik (1993).

¹⁹Burrell et al. (2009); LeCroy and Whitaker (2005); Whitaker (2014).

Table 2.2

Selected Home Visitor Characteristics at Baseline, by Evidence-Based Model

Characteristic (%)	Overall	HFA	NFP
<u>Sociodemographic</u>			
Age			
Under 30 years	25.4	31.9	18.0
30-39 years	30.0	32.4	27.3
40-49 years	22.6	18.1	27.9
50 years or older	21.9	17.6	26.8
Race/ethnicity			
Hispanic	20.4	20.5	20.3
Non-Hispanic white	55.6	51.9	59.9
Non-Hispanic black	17.1	21.4	12.1
Other/multiracial	6.9	6.2	7.7
Bilingual in English and Spanish ^a	20.9	20.0	22.0
<u>Education and employment background</u>			
Highest level of education			
Some college or less ^b	13.2	24.8	0.0
Associate's degree or training program degree	12.2	17.6	6.0
Bachelor's degree	62.1	50.0	76.0
Master's degree or higher	12.5	7.6	18.0
Field of study ^c			
Psychology/child development	31.9	51.3	10.9
Education/early childhood education	20.7	33.2	7.1
Social work/social welfare	20.2	35.2	3.8
Nursing	52.9	9.5	100.0
Other	18.1	27.6	7.7
Has three or more years of experience in home visiting ^d	55.6	48.5	63.5
Sample size	393	210	183

SOURCES: Calculations based on data from the MIHOPE home visitor baseline survey and the MIHOPE-Strong Start home visitor survey.

NOTES: HFA = Healthy Families America, NFP = Nurse-Family Partnership.

^aAdditionally, some home visitors (3.8 percent overall) said they were bilingual in English and a language other than Spanish.

^bThis category includes vocational/technical training, some college, and high school diploma/General Educational Development (GED) certificate or less.

^cPercentages sum to more than 100 because respondents could choose multiple fields of study.

^dThis category includes home visitors with at least three years of experience providing home visiting services to families or at least three years in their current position.

HFA home visitors were 29 or younger, compared with 18 percent of NFP home visitors. The majority of home visitors from both HFA and NFP (56 percent) self-identified as non-Hispanic white, while other home visitors in the study self-identified as Hispanic²⁰ (approximately 20 percent) or non-Hispanic black (17 percent). Only a small minority self-identified as Asian, other race, or multiracial.

The age differences seen across the two models may be partly attributed to the models' differing requirements for the college education of home visitors. Whereas nearly all NFP home visitors had at least a bachelor's degree (94 percent), reflecting model requirements, about 58 percent of HFA home visitors had a bachelor's degree or higher.²¹ All NFP home visitors were trained in nursing, compared with 10 percent of HFA home visitors. This is in line with model specifications, given that NFP requires that home visitors have a nursing degree, whereas HFA services may be delivered by other types of professionals or nondegreed professionals with a minimum of a high school diploma or equivalent. The most common fields of study for HFA home visitors were psychology or child development (51 percent) and social work or social welfare (35 percent).

About half of the sample of home visitors had three or more years of experience providing home visiting services to high-risk families, with home visitors in NFP programs more likely to have at least three years of experience than home visitors in HFA programs. Some of the home visitors (17 percent) in the study were very new to home visiting, having less than a year of experience, and another 28 percent had one to two years of experience (not shown). As described further in Chapter 3, lack of experience working with high-risk or high-need families may result in home visitors feeling unprepared for dealing with challenging circumstances or families in crisis.²² At the same time, home visitors who have worked in the field for years may be more likely to experience stress from doing close work with families in challenging situations and thus feel burned out.²³

Characteristics of Families at Baseline

As summarized in the following subsections, Table 2.3 shows the characteristics of mothers in the sample at the time of study entry. The information on sociodemographic

²⁰Home visitors or families who identify as Hispanic can be of any race.

²¹It is unclear why not all home visitors in NFP programs reported having a bachelor's degree when the model requires that they have a bachelor's degree in nursing. Misreporting might have occurred, or it is possible that a local program made exceptions to the model requirement.

²²Daro, McCurdy, Falconnier, and Stojanovic (2003).

²³Wasik (1993).

Table 2.3

Selected Family Characteristics at Baseline, by Research Group

Characteristic	Overall	Program Group	Control Group
<u>Maternal sociodemographic</u>			
Average gestational age ^a (weeks)	16.8	16.8	16.9
Pregnancy stage (%)			
First trimester	37.1	38.0	36.1
Second trimester	54.6	53.4	55.9
Third trimester	8.3	8.5	8.1
Age of mother			
Average age ^b (years)	22.3	22.2	22.3
Age 15-20 (%)	47.1	47.0	47.3
First-time mother (%)	84.0	84.0	84.0
Race/ethnicity (%)			
Mexican or Mexican-American	25.3	25.6	25.1
Other Hispanic	17.5	17.9	17.1
Non-Hispanic white	21.1	19.6	22.8
Non-Hispanic black	26.6	28.2	24.6
Other/multiracial	9.5	8.8	10.3
Foreign-born (%)	22.3	22.5	22.1
Highest level of education (%)			
Less than high school diploma or General Educational Development (GED) certificate	34.1	34.5	33.6
Under 21 years	22.7	22.5	23.0
21 years or older	11.4	12.0	10.6
High school diploma or GED	37.9	36.9	39.1
More than high school diploma or GED	28.0	28.6	27.3
Biological father lives in the home (%)	37.2	37.4	37.1
<u>Health care coverage and use and health status (%)</u>			
Insurance coverage of mother			
Medicaid/Children's Health Insurance Program	86.3	86.7	85.9
Private	4.0	4.1	3.8
Uninsured	8.1	7.3	8.9
Other public insurance	1.6	1.8	1.4

(continued)

Table 2.3 Family Characteristics at Baseline (continued)

Characteristic	Overall	Program Group	Control Group
Initiated prenatal care in first trimester (among those who enrolled in study in second or third trimester)	71.2	73.3	68.8
Has usual source of prenatal care	82.8	82.9	82.8
Maternal health self-rated “poor” or “fair”	10.5	10.5	10.5
<u>Risk factors (%)</u>			
Tobacco use			
Any smoking in 3 months prior to pregnancy	16.9	16.7	17.1
Any current smoking	9.2	9.0	9.4
Smoking is permitted in the home	18.8	18.7	18.9
Substance use (alcohol or drugs) prior to pregnancy			
Any heavy drinking	2.9	2.8	3.0
Any binge drinking	23.8	23.8	23.8
Any use of illicit drugs	15.3	15.0	15.7
Maternal mental health concerns (depression or anxiety)			
Depressive symptoms	37.8	36.0	39.9
Anxiety symptoms	22.7	21.3	24.4
Food insecurity	53.2	52.6	53.9
Pregpregnancy body mass index			
Underweight	5.8	6.6	4.9
Obese	29.8	31.2	28.1
Maternal experience of physical violence or psychological battering among women in a relationship			
Any physical violence toward mother ^c	8.5	8.5	8.4
Experience with battering	7.7	9.0	6.0
Sample size	2,900	1,572	1,328

SOURCES: Calculations based on study intake data, data from the MIHOPE and MIHOPE-Strong Start family baseline surveys, state vital records data, and Medicaid enrollment data.

NOTES: For detailed descriptions of measures, please see Appendix B.

^aStandard deviations: overall = 6.9; program group = 6.9; control group = 6.9.

^bStandard deviations: overall = 5.3; program group = 5.2; control group = 5.4.

^cFor MIHOPE respondents, the period referenced is the previous year. For MIHOPE-Strong Start families, the period is the prior three months.

characteristics, the self-reports of particular risk-related behaviors, and the conditions at study entry and prior to pregnancy provide a sense of the risk profiles among program group women before they could have received home visiting services. Table 2.3 also shows distributions for both program and control groups, to assess whether differences exist despite the use of random assignment. There were a few statistically significant differences between research groups, but the impact analyses control for many of these and other baseline characteristics.

Sociodemographic Characteristics

Gestational age and stage of pregnancy. The average sample member was 17 weeks along in her pregnancy, which is prior to midgestation (happening at 20 weeks), at the time of the random assignment.²⁴ Women in NFP programs were earlier in their pregnancy (15 weeks) than women in HFA programs (20 weeks).²⁵ The majority of women (55 percent) enrolled in the sample in their second trimester and 37 percent enrolled during the first trimester. About 8 percent of the sample enrolled early in the third trimester (weeks 28 through 32), and a very small number of women included in the sample enrolled later than the thirty-second week of pregnancy, for unknown reasons; possibly the due date was misreported when study eligibility was determined. Most of the women who enrolled during the third trimester were in HFA programs (210 out of 241 women), since NFP did not allow enrollment after the twenty-eighth week of pregnancy, which is the first week of the third trimester. A small number of study participants from NFP (14 women) did enter the study after the twenty-eighth week. This typically was because the mother gave an expected due date that was misaligned with the gestational age at study entry based on the obstetric estimate from vital records data.²⁶ In a few cases, women in the MIHOPE-Strong Start sample from NFP programs reported expected due dates that would have put gestational age after the twenty-eighth week; vital records data later confirmed this.²⁷

²⁴The subsection “Duration and Timing of Visits,” in Chapter 3, discusses at what point sample members typically received their first home visit.

²⁵Information on family characteristics at baseline across the two models is shown in Appendix Table B.2. Information on the characteristics of only program group families across the two models is shown in Appendix Table B.3.

²⁶This was confirmed by comparing gestational age at study intake based on the mother’s self-reported expected due date with the gestational age at study intake based on the obstetric estimate of gestation as recorded on the birth record.

²⁷These women may have been eligible for home visiting services because NFP’s local programs can submit a formal variance to get approval from the national model to enroll high-risk women beyond

Also, while the vast majority of sample members were pregnant with their first child, 16 percent were not, nearly all of whom were in HFA programs. Information on birth parity comes from vital records data. Although first-time motherhood was a criterion for eligibility in NFP programs, a handful of sample members in NFP programs (about 1 percent) were not first-time mothers according to vital records. It is unclear why this would be the case, but it is possible that either the sample member or the local program was not counting a stillbirth when first-time motherhood eligibility was determined, although a birth that was technically a stillbirth could possibly count as a prior birth in vitals data depending on the state.²⁸

Maternal age. In the broader literature, younger women (and women older than 35) are more likely to have a low-birth-weight baby or a preterm birth.²⁹ This pattern holds true primarily for Hispanic and non-Hispanic white women but not as strongly for non-Hispanic blacks.³⁰ Women in this sample were young, with an average age of 22 years. Almost half were between the ages of 15 and 20 years.

Race, ethnicity, and nativity status. Persistent black-white disparities in birth outcomes have been widely documented across studies.³¹ Prior research has also noted considerable heterogeneity in birth outcomes among Hispanic subgroups, with higher risk found among Puerto Rican women and lower risk found among Mexican or Mexican-American mothers.³² Research on Hispanic women has further found that foreign-born women have better birth outcomes, on average, than their native-born counterparts.³³ Table 2.3 shows that women in MIHOPE-Strong Start were racially and

the end of their twenty-eighth week of pregnancy. The study team could not confirm that this was the case.

²⁸Sanger (2012).

²⁹Kramer (1987); Institute of Medicine (U.S.) Committee on Understanding Premature Birth and Assuring Healthy Outcomes (2007). Young maternal age is defined differently across the studies of birth outcomes, and no clear threshold of risk by age categorization exists. Some studies define young mothers as those who are less than 18 years old, whereas others define it as being less than 20 years old, and others suggest it is less than 21.

³⁰Rates of low birth weight appear to rise at a younger age for non-Hispanic blacks than for non-Hispanic whites, and the slope of the rise is greater for blacks than for whites as their age increases. According to the weathering hypothesis (Geronimus, 1996), the effects of social inequality and discrimination on maternal health for black women, in particular, compound to affect reproductive outcomes at earlier ages than for white women.

³¹Blumenshine et al. (2010); Geronimus (1996); Institute of Medicine (U.S.) Committee on Understanding Premature Birth and Assuring Healthy Outcomes (2007); Lu and Halfon (2003); Lu et al. (2010).

³²Bediako, BeLue, and Hillemeier (2015); Fuentes-Afflick and Lurie (1997).

³³Cervantes, Keith, and Wyshak (1999); Flores et al. (2012); Landale, Oropesa, and Gorman (1999); Singh and Yu (1996). Scholars have attributed the patterns based on nativity status to both a

ethnically diverse, which is a necessary factor in the study's ability to examine whether home visiting effects vary by maternal race and ethnicity. Twenty-one percent of the sample identified as non-Hispanic white and 27 percent as non-Hispanic black. Notably, 43 percent of the sample identified as Hispanic, with 25 percent of the sample identifying as Mexican or Mexican-American and 18 percent as coming from another Hispanic origin.³⁴ Also, 22 percent of the sample were foreign born, and most of those women identified as Hispanic (results not shown).

Maternal education. Across different studies, researchers have found that rates of preterm-birth and low-birth-weight infants are higher among women with lower educational attainment.³⁵ Women in this study had low levels of education, with only about two-thirds having a high school diploma or General Educational Development (GED) certificate. This partly reflects the sample's young age. For example, about 11 percent of the sample were 21 years of age or older and had not completed high school or received a GED certificate. In contrast, about 23 percent of the sample were below age 21 and did not have either of these credentials.

Biological father being present in the home. Research has found that the prevalence of preterm birth and low birth weight is higher among unmarried mothers than among their married counterparts.³⁶ The reasons for this pattern are debatable, although common theories include selection into marriage³⁷ as well as married people having more protective systems in place (such as increased social support and resources as well as lower stress).³⁸ This same strand of research has found that women in cohabiting relationships have a greater likelihood of experiencing adverse birth outcomes than married women but a lower risk than single, noncohabiting mothers.³⁹ Thirty-seven percent of the MIHOPE-Strong Start sample reported that the biological father

healthy migrant effect and to negative acculturation (with resulting increases in areas such as obesity and smoking rates) among the second generation and beyond.

³⁴Due to small sample sizes, the team was unable to break down the statistics on the other Hispanic, non-Mexican mothers by country or ethnic origin.

³⁵Blumenshine et al. (2010); Institute of Medicine (U.S.) Committee on Understanding Premature Birth and Assuring Healthy Outcomes (2007).

³⁶Kane (2016).

³⁷*Selection into marriage* suggests that certain factors, such as better health and higher socioeconomic status, place individuals at a greater likelihood of entering into marriage. These factors, in turn, are also associated with better birth outcomes, making it difficult to disentangle whether marriage, per se, leads to better birth outcomes.

³⁸Kane (2016).

³⁹Shah, Zao, and Ali (2011).

lived in the home at the time of the baseline interview. As is the case with education, these low rates of cohabiting most likely reflect the young age of the study sample.

Health care coverage, health care use, and health status. Reflecting the prioritization of local program recruitment, most women in the study were covered by Medicaid when they enrolled in MIHOPE-Strong Start (86 percent), although a small percentage were uninsured at the time of study entry (8 percent). Among the 63 percent of women who enrolled in the study in the second or third trimester, 71 percent had initiated prenatal care during the first trimester. This is generally in keeping with reports of Medicaid populations.⁴⁰ Most women in the sample reported having a usual source of prenatal care, although this information was only collected from the subsample of women who enrolled through MIHOPE-Strong Start (1,030 mothers). Finally, only about 11 percent of the sample reported being in poor or fair health. Although it is a subjective measure, self-reported health status is a fairly robust indicator of underlying health and is predictive of both later morbidity and mortality, according to prior literature.⁴¹

Risk Factors

Notwithstanding the young age and low education levels of the sample, participants had fairly positive health profiles on some indicators of risk for poor birth outcomes. On others, the portrait of risk is less positive.

Most of the information on baseline risk factors comes from the family baseline survey. When information was missing or of poorer quality than administrative data, administrative records (specifically, Medicaid enrollment data and some vital record reports of prepregnancy or pregnancy behaviors) were used. Note that prepregnancy or pregnancy behaviors in vital records pull information from medical records. Medical — and, in turn, vital — record indicators for behaviors such as smoking are, however, based on what the mother reported to her health care provider before and during pregnancy, as well as at the time of birth, and are thus essentially self-reports.

For many of the risk factors discussed below, it is unknown whether there are particularly sensitive or critical periods during pregnancy when the experience of a risk increases the likelihood of poor birth outcomes, or conversely, whether the reduction of a risk during a particular month or stage of pregnancy would lead to improved newborn health. That said, it is generally known that experiencing these risks at some point during pregnancy can contribute to poor birth outcomes, and that the more severe or intense

⁴⁰Curtin et al. (2013).

⁴¹Idler and Benyamini (1997); Latham and Peek (2013); Schnittker and Bacak (2014).

the risk (for example, heavy smoking versus light smoking during pregnancy), the greater the risk of adverse health for the newborn.⁴²

Smoking. The relationship between maternal smoking during pregnancy and adverse birth outcomes — including intra-uterine growth restriction, low birth weight, and preterm birth — is well-documented.⁴³ Among MIHOPE-Strong Start sample members, about 9 percent reported smoking at the time of study entry. This statistic is similar to the prevalence of smoking during pregnancy at the national level (8-10 percent),⁴⁴ but it is lower than for pregnant Medicaid beneficiaries nationally (18 percent).⁴⁵ About 17 percent of the study sample reported smoking in the three months prior to pregnancy.⁴⁶ This rate is higher than the national rate for smoking during this period (about 11 percent in 2014) but comparable to estimates for women covered by Medicaid (about 17 percent in 2014).⁴⁷

The relatively low estimates of smoking among the study sample may partly reflect the racial and ethnic diversity of families in MIHOPE-Strong Start. Specifically, white mothers tend to have higher rates of smoking before or during pregnancy than black or Hispanic mothers.⁴⁸ Even among low socioeconomic status groups, rates of smoking during pregnancy are higher among white women than among black or Hispanic women.⁴⁹ This pattern is reflected in MIHOPE-Strong Start, with 26 percent of white mothers reporting smoking at study entry versus 7 percent of black mothers and less than 2 percent of Hispanic mothers (not shown). Furthermore, smoking rates during pregnancy tend to be lower among foreign-born women than among native-born women;⁵⁰ this pattern is also found in the study sample (not shown).

⁴²Institute of Medicine (U.S.) Committee on Understanding Premature Birth and Assuring Healthy Outcomes (2007).

⁴³Cnattingius (2004); Floyd et al. (1993); Institute of Medicine (U.S.) Committee on Understanding Premature Birth and Assuring Healthy Outcomes (2007); Kramer (1987).

⁴⁴Curtin and Mathews (2016); Tong et al. (2013).

⁴⁵Tong et al. (2013).

⁴⁶Information on smoking in the three months prior to pregnancy was primarily based on data from vital records, which was based on mothers' self-reports in medical records. If these data were unavailable, then MIHOPE baseline survey responses were used (the question of smoking at study entry was not asked in the MIHOPE-Strong Start baseline survey).

⁴⁷Curtin and Mathews (2016).

⁴⁸Curtin and Mathews (2016).

⁴⁹Ventura, Hamilton, Mathews, and Chandra (2003).

⁵⁰Ventura, Hamilton, Mathews, and Chandra (2003).

Because all of the prior estimates (for both the study sample and the national or Medicaid-specific comparisons) were based on self-reports, they are prone to under-reporting due to social stigma or recall bias.⁵¹ Biomarker data, such as urine cotinine levels, are the best source of information on actual smoking, but these data were not available in the national data or in this study, as they are expensive to collect. Still, while this study likely includes an underestimate of true smoking prevalence, the sample nevertheless had lower smoking rates than did the samples in some of the earlier studies of home visiting using similar measures. Specifically, about 40 percent of the sample members in the NFP Elmira trial were self-reported smokers at study entry and almost 30 percent of the sample in the HFA New York trial reported they smoked during pregnancy.⁵²

Substance use prior to pregnancy. The negative effect of heavy drinking on infant health is also well-documented and related to a range of negative birth outcomes, including preterm birth, low-birth-weight infants, and congenital anomalies.⁵³ Illicit drug use, such as of opioids and cocaine, is also correlated with these outcomes, although some of this effect is attributed to having other social, psychosocial, behavioral, and biomedical risk factors, such as smoking and stress, in addition to drug use.⁵⁴

In this study, information on alcohol consumption and the use of illicit drugs prior to pregnancy was only collected from the subsample of women who enrolled through MIHOPE (1,845 mothers). In this group, the rates of heavy drinking (defined as consuming seven or more drinks per week in the three months prior to pregnancy) were low, at 3 percent, although 24 percent of participants reported an episode of binge drinking (consuming four or more drinks on one occasion) in the three months prior to pregnancy. The use of any illicit drugs, which could include marijuana, overuse of prescription medication, crack, cocaine, or opioids, in the month prior to pregnancy was about 15 percent. Similar to the statistics on smoking, these reports were likely to understate the degree of drinking and substance use due to self-reporting.

⁵¹Rebagliato (2002); Patrick et al. (1994).

⁵²In the NFP Elmira trial, smokers were defined as women who reported smoking five or more cigarettes a day (Olds, Henderson, Tatelbaum, and Chamberlin, 1986). This is a higher threshold than any amount of smoking at all during pregnancy, which was the measure used in the HFA New York trial (Lee et al., 2009) and what Table 2.3 uses for smoking at study entry and three months prior to pregnancy. In fact, Kitzman and colleagues (1997) noted that the prevalence of smoking at study entry in the NFP Elmira trial was 55 percent when smoking was defined as smoking at least one cigarette a day.

⁵³Forray (2016).

⁵⁴Schempf and Strobino (2008).

Mental health. Maternal anxiety and depression both play a role in adverse birth outcomes, partly through their influence on health behaviors (including smoking, poor nutritional habits, and lack of sleep).⁵⁵ Other research suggests that these conditions may have an independent physiological effect by causing alterations in the hormonal environment.⁵⁶ In contrast to their access to health care and relatively low rates of smoking, the sample had high rates of anxiety or depressive symptoms.

The prevalence of these symptoms is higher in the MIHOPE-Strong Start sample than the national averages among pregnant women. As Table 2.3 shows, about 38 percent of mothers reported having depressive symptoms during pregnancy, compared with national estimates that range from 14 to 23 percent of pregnant women.⁵⁷ Similarly, 23 percent of the study sample reported having symptoms of anxiety, compared with 14 percent of pregnant women with these symptoms in the 2011 Pregnancy Risk Assessment Monitoring System (PRAMS) data.⁵⁸ While the study sample exhibited elevated rates of mental health concerns compared with pregnant women on a national scale, the rates of elevated depressive or anxiety symptoms were similar to populations in earlier home visiting studies.⁵⁹ Note that the MIHOPE-Strong Start assessments of depressive and anxiety symptoms, as was the case in earlier home visiting studies, were based on widely used and validated instruments. In clinical practice, mental health professionals often use these instruments as a screening tool and follow up with detailed interviews with their clients to reach a diagnosis of depression or anxiety.

Food insecurity and prepregnancy weight. A little more than half (53 percent) of the sample reported experiencing food insecurity in the year prior to study entry. This is notably higher than the national average of 21 percent of households with children that reported food insecurity.⁶⁰ Food insecurity has been associated with greater risk of

⁵⁵Institute of Medicine (U.S.) Committee on Understanding Premature Birth and Assuring Healthy Outcomes (2007); Zuckerman, Amaro, Bauchner, and Cabral (1989).

⁵⁶Glover (2011); Mancuso et al. (2004).

⁵⁷American College of Obstetricians and Gynecologists (n.d.). As Appendix B further describes, depressive symptoms and anxiety symptoms in MIHOPE-Strong Start were based on self-report-based instruments (the Center for Epidemiological Studies of Depression scale [CES-D] and the Generalized Anxiety Disorder scale [GAD-7]). For the national estimate of depression, ACOG does not cite the tool it used to measure and define depression.

⁵⁸Pregnancy Risk Assessment Monitoring System (PRAMS) Data Portal (2018). PRAMS provides surveillance data collected across most states on maternal health and well-being before, during, and shortly after pregnancy, as well as indicators on infant health. Anxiety, in PRAMS, is indicated by whether the mother reported having anxiety in the three months before she got pregnant.

⁵⁹Ammerman et al. (2010); Duggan et al. (2004).

⁶⁰Coleman-Jensen, McFall, and Nord (2013).

having a low-birth-weight infant,⁶¹ although its independent contribution (as distinguished from, for example, poverty or maternal body mass index) is often hard to disentangle.

Federal food assistance programs that are intended to help low-income pregnant women and families with food insecurity include the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) and the Supplemental Nutrition Assistance Program (SNAP).⁶² WIC funding also supports the provision of health care referrals and nutrition education, and research on WIC has found that participation leads to improved birth outcomes.⁶³ In the current study, information on WIC and SNAP participation was limited to the families who were recruited in local programs participating in MIHOPE (1,845 mothers). Of those families, most (78 percent) were receiving benefits from either WIC or SNAP at study entry, with about 64 percent reporting the receipt of WIC (not shown). In fact, even with the receipt of WIC or SNAP, food insecurity was a concern for sample members, with 57 percent of WIC or SNAP recipients reporting food insecurity, compared with 44 percent of those who did not receive WIC or SNAP having this concern (not shown). This might indicate that WIC and SNAP tend to provide services to families who are more likely to have either food insecurity or more severe food insecurity, than families not receiving benefits from these programs.⁶⁴

It has been noted that food insecurity is correlated with obesity.⁶⁵ Thirty percent of the sample were obese prior to pregnancy. Research on the relationship between maternal obesity and birth outcomes is mixed. Some research suggests that there is an almost linear relationship between maternal weight and infant birth weight, in particular.⁶⁶ Accordingly, some studies have found that obese women are more likely to give birth to infants who are large for gestational age, an outcome that can seriously complicate labor and delivery.⁶⁷

⁶¹Ivers and Cullen (2011).

⁶²As mentioned in Chapter 4, in addition to helping families deal with food insecurity, WIC programs provide other services, such as nutrition education, screening, and referrals.

⁶³Bitler and Currie (2005).

⁶⁴Alaimo, Briefel, Frongillo, and Olson (1998); Wilde (2007).

⁶⁵Ivers and Cullen (2011); Pan, Sherry, Njai, and Blanck (2012).

⁶⁶Goldenberg and Culhane (2007); Yu et al. (2013).

⁶⁷Leddy, Power, and Schulkin (2008).

A much smaller percentage (6 percent) of the women in the sample were underweight. Underweight women are at higher risk of giving birth to infants who are low birth weight, preterm, and small for gestational age.⁶⁸

Physical intimate partner violence. Although the effects of intimate partner violence during pregnancy are not well documented, some studies have shown that intimate partner violence (either physical or psychological) is associated with increased risk of low birth weight and preterm birth. Furthermore, this factor is more likely to affect low-income, predominantly single women.⁶⁹

Among women who were in a relationship when they entered the study (2,284 women), 14 percent indicated being the recent victim of physical violence or battering.⁷⁰ About 9 percent reported having experienced physical intimate partner violence, and about 8 percent reported having experienced psychological battering. Physical intimate partner violence involves discrete acts of physical violence such as hitting, shoving, kicking, and beating perpetrated by a spouse or partner, whereas psychological battering is defined as a syndrome of control and entrapment that may or may not be accompanied by physical attacks.⁷¹ Although it is challenging to find comparable estimates for low-income women nationwide, particularly for battering, the rate of physical intimate partner violence for women in this study is higher than the available national estimate. In the 2011 PRAMS data, 5 percent of pregnant women enrolled in Medicaid had husbands or partners who had inflicted physical violence during the 12 months prior to pregnancy.⁷²

Conclusion

To be eligible for MIHOPE-Strong Start, local programs had to be interested in participating in the study, have been in operation for at least two years, and have at least three full-time home visitors. The study team also prioritized the recruitment of programs that served a prenatal client population mostly covered by Medicaid. Accordingly, local programs in MIHOPE-Strong Start were large and most had been in operation for six or

⁶⁸Han et al. (2011); Goldenberg and Culhane (2007).

⁶⁹Alhusen, Ray, Sharps, and Bullock (2015).

⁷⁰For sample members who responded to the MIHOPE baseline survey, the period referenced was the previous year. MIHOPE-Strong Start baseline survey respondents were asked about the previous three months. See Appendix B for details.

⁷¹Smith, Earp, and DeVellis (1995).

⁷²Pregnancy Risk Assessment Monitoring System (PRAMS) Data Portal (2018). In PRAMS, physical violence is defined as having a husband or partner who pushed, hit, slapped, kicked, choked, or physically hurt the mother in any other way.

more years. The study team also targeted recruitment toward local programs that were located in areas without other comparable home visiting services and without access to services under other parts of the Strong Start for Mothers and Newborns Initiative. The home visitors working in these programs were diverse in age and racial and ethnic background, and most were college educated. However, about half of the home visitors had less than three years of experience in providing home visiting services.

The sociodemographic characteristics of families in the study suggest that programs targeted a population who displayed some risks for poor birth outcomes. The average woman was young, had a low level of education, and was not cohabiting with the baby's father. About one in two women reported experiences with food insecurity in the year prior to enrolling in the study. Over 40 percent reported elevated symptoms of depression or anxiety. Yet, on measures of health risks such as smoking, the sample exhibited more health-protective characteristics than has been found in some of the earlier trials of HFA and NFP or other low-income Medicaid populations.

These findings underscore the varying constellations of strengths and risks that are found among women served by local home visiting programs. The next chapter turns to a detailed examination of how the local programs implemented home visiting services for the sample members in the study's program group.

Chapter 3

Implementation of Home Visiting Services

This chapter describes the implementation of home visiting services that occurred with families who were randomly assigned to the program group in the Mother and Infant Home Visiting Program Evaluation-Strong Start (MIHOPE-Strong Start). As discussed in Chapter 1, prior studies have not provided information in a systematic way about how local programs are structured, how front-line staff members are supported, and whether such factors matter for understanding differences in the services provided to families during pregnancy and over the course of the infant's first year.¹

This chapter describes the implementation of home visiting programs by tracing various processes, including:

- reviewing **local programs' priorities, policies and procedures, and implementation system infrastructure**;
- documenting **front-line staff members' perceptions** of the local programs' sources of support and work dynamics;
- describing the **services that were delivered to families** during pregnancy and over the first year after birth, including measures of **dosage** (captured by the number of home visits received, time spent in visits, and duration of participation); **provision of referrals**; and **content of home visits**; and
- examining **how services varied** by family-level, home visitor-level, and local program-level characteristics.

In the prior home visiting research, there is limited information about the associations between implementation system components and improvements in particular outcomes.² However, research in implementation science suggests that having an effective implementation system is important for ensuring fidelity to an evidence-based model.³ Fidelity is important, as adhering to model standards increases the probability of achieving outcomes,⁴ and as noted in Chapter 1, the logic models of both Healthy Families

¹Issel et al. (2011).

²Casillas, Fauchier, Derkash, and Garrido (2016); Paulsell, Del Grosso, and Supplee (2014).

³Fixsen et al. (2005).

⁴Daro, Boller, and Hart (2014).

America (HFA) and Nurse-Family Partnership (NFP) describe how home visiting activities are linked to the models' expected outcomes, including improvements in prenatal health behaviors and care, healthy births, and improved child health. Therefore, most implementation features examined in MIHOPE-Strong Start are related to understanding what makes for stronger home visiting implementation in general. When the information is available, implementation features specifically targeting prenatal and birth outcomes are discussed.

Additionally, some research suggests that a range of home visiting outcomes could be affected by the overall extent of a family's participation in home visiting.⁵ Therefore, in this study, such factors as the quantity and duration of services delivered to families were also measured. In such areas as referrals for specific types of services or the topics of discussion in home visits, measures of services delivered are presented specific to prenatal, birth, and related outcomes.

Findings in Brief

- **Local programs and home visitors placed a high priority on improving prenatal health and promoting healthy births as well as health-related outcomes after birth.** In line with these prioritizations, the majority of local programs reported having policies and infrastructure in place to support home visitors in addressing these outcomes.
- **Home visitors, in turn, reported feeling adequately supported by the implementation system of their local programs and felt comfortable and effective in their roles.** For example, almost all home visitors reported having one-on-one supervision sessions at least weekly, and the majority of home visitors reported receiving guidance on prenatal health from their supervisors once a month or more often.
- **Families who engaged in at least one home visit received eight visits prenatally and participated for almost four months prior to the infant's birth, on average.** These findings are in line with those from prior studies of the two models and the broader home visiting literature, with the number of home visits received being lower than model expectations. About 14 percent of program group families, however, never received a home visit either during pregnancy or after birth.

⁵Korfmacher, Kitzman, and Olds (1998); Lyons-Ruth and Melnick (2004); Olds, Henderson, Tatelbaum, and Chamberlin (1988); Raikes et al. (2006).

- **Home visitor continuity was high.** Over three-quarters of families who received at least one visit received all of their visits from a single home visitor.
- **Among families who participated in home visiting, the most common type of referral during pregnancy (42 percent of families) was for prenatal health.**⁶ This suggests that despite families having access to prenatal care at study entry, as described in Chapter 2, home visitors may have been addressing some gaps in their prenatal health and health care throughout pregnancy. Among the subset of families for whom information was available (848 families), almost all of them (96 percent) had at least one home visit during pregnancy in which they discussed prenatal health.⁷
- **Most mothers who initiated home visiting during pregnancy were still enrolled at the time of the child’s birth, although retention waned in the first year after birth for about half of enrolled families.** About 81 percent of families who received at least one home visit during pregnancy were still enrolled around the time of birth, but a smaller percentage of families (48 percent) were still participating in home visiting 12 months after the child’s birth.
- **Mothers who were more vulnerable to poor birth outcomes were as likely as women who were less vulnerable to engage in home visiting and did so to a similar degree.** Participation during pregnancy, when examined by the number of home visits or length of time in the program, did not vary by the mother’s age, by whether the mother smoked, had low self-rated health, or was food insecure, even after adjusting for correlations across other family, home visitor, or local program characteristics.

Local Program Implementation Characteristics

As described in Chapter 1, the implementation study was designed to investigate aspects of program operations that are important for understanding how local programs

⁶Prenatal health referrals address areas such as nutrition, substance use, and childbirth education, in addition to physician-based prenatal care (see Appendix Table C.1).

⁷Discussions of prenatal health could include topics such as nutrition, abstinence from harmful substances, prenatal health care, and childbirth preparation (see Appendix Table C.2).

were structured and how staff members were supported to provide the services as intended, in addition to documenting variation therein. The MIHOPE-Strong Start third annual report began this investigation by describing and comparing key elements of local programs' service plans (the blueprint for service delivery) and some components of implementation systems (infrastructure and support to carry out planned services). These features may increase home visitors' ability to provide a range of services to families.⁸

Building on the information presented in the third annual report, this section takes a closer look at different components of local program implementation, with a particular focus on assessing whether the programs and home visitors in MIHOPE-Strong Start were focused on and equipped to improve birth outcomes and to address the diverse types of risks found among program group families.

Priorities of Programs and Staff

The first step in improving a particular outcome is for the evidence-based models and local programs to prioritize that outcome. As described in an earlier report from the study, the local HFA and NFP programs aimed to improve a broad set of outcomes outside those that are the focus of MIHOPE-Strong Start.⁹ As a result, local home visiting programs could vary in the degree of emphasis they placed on specific aspects of family well-being. Moreover, the programs were intended to serve families for multiple years after a child's birth. Thus, it was not a given that local programs or home visitors would prioritize prenatal health and healthy births highly or more highly than other potential areas of focus.

Both evidence-based models prioritized improving health-related behaviors during pregnancy and promoting healthy births, ranking these factors 7 or higher on a scale of 10 (see Table 3.1). They also emphasized fostering maternal well-being outside of birth and improving parenting practices to promote child health. Local program managers and home visitors across both models similarly ranked intended outcomes in these categories highly. For example, on average, home visitors gave a rating of 9 or 10 to improving birth outcomes, maternal health during pregnancy, and infant health-related practices. Home visitors also prioritized addressing psychosocial and behavioral health and intimate partner violence concerns to a high degree.¹⁰

⁸Lee, Crowne, Faucetta, and Hughes (2016).

⁹Lee, Crowne, Faucetta, and Hughes (2016).

¹⁰Note that Appendix Table C.3 presents the priority ratings of local program managers and home visitors across a broader range of family outcomes than is shown in Table 3.1.

Table 3.1
Priority Ratings for Intended Outcomes of the
Evidence-Based Models, Program Managers, and Home Visitors

Outcome to Address (mean)	Model Developer Rating (0 to 10)		Local Program Manager Rating (0 to 10)			Home Visitor Rating (0 to 10)		
	HFA	NFP	Overall	HFA	NFP	Overall	HFA	NFP
<u>Birth outcomes</u>	9	10	9.2	8.9	9.4	9.2	8.9	9.5
<u>Maternal health and well-being</u>								
During pregnancy								
Health-related behaviors ^a	7	10	8.9	8.8	9.1	9.1	8.9	9.3
Outside of pregnancy								
Health-related behaviors ^b	7	10	8.0	8.1	7.8	7.9	8.0	7.7
Tobacco use	7	10	8.2	7.9	8.6	8.1	8.0	8.2
In general								
Family planning and birth spacing	7	10	8.8	8.5	9.1	8.7	8.6	8.9
Mental health and substance use	8	10	9.1	8.9	9.3	8.9	8.8	8.9
Intimate partner violence	8	10	9.2	9.1	9.3	8.9	8.9	8.8
<u>Parenting to support child health</u>								
Breastfeeding	10	10	9.0	8.7	9.3	9.0	8.7	9.2
Child preventive care	10	10	9.5	9.6	9.4	9.5	9.5	9.5
Sample size	1	1	66	37	29	393	210	183

SOURCES: Calculations based on data from the MIHOPE evidence-based model developer survey, the MIHOPE program manager baseline survey, the MIHOPE-Strong Start program manager survey, the MIHOPE home visitor baseline survey, and the MIHOPE-Strong Start home visitor survey.

NOTES: HFA = Healthy Families America, NFP = Nurse-Family Partnership.

^aThe MIHOPE-Strong Start program manager and home visitor surveys ask about four specific outcomes related to promoting good prenatal health (good nutrition, proper exercise, proper rest, and reducing tobacco use). A staff member's highest rating among these four items was used as the staff member's priority rating for health-related behaviors during pregnancy.

^bThe MIHOPE-Strong Start program manager and home visitor surveys ask about three specific outcomes related to promoting maternal health outside of pregnancy (good nutrition, proper exercise, and proper rest). A staff member's highest rating among these three items was used as the staff member's priority rating for health-related behaviors outside of pregnancy.

Local Program Policies and Procedures

The evidence-based models specify the services that local programs are expected to deliver to families in order to achieve outcomes, including information gathering, providing education and support, and providing referrals to other resources in the community. In addition, local programs have specific policies and procedures for how home visitors are expected to perform their tasks.

In the domain of prenatal health, nearly all local programs in the study expected home visitors to screen for whether or not pregnant women were receiving prenatal care, to monitor when and where women received prenatal care, and to help them follow through on prenatal care providers' recommendations (results not shown).¹¹ There were slight differences between the evidence-based models in two areas. All NFP programs had formal documentation to help remind home visitors to monitor women's use of prenatal care services, compared with 73 percent of HFA programs having such documentation (results not shown). Yet all local HFA programs reported that supervisors made it part of program operations to monitor home visitors' activities around prenatal care, compared with 71 percent of NFP programs (results not shown).

Both HFA and NFP programs also had policies and procedures in place for addressing maternal mental health, substance use, and intimate partner violence — areas that are relevant to MIHOPE-Strong Start because of the risks they present for poor birth outcomes. Moreover, as described in Chapter 2, the sample in MIHOPE-Strong Start had a high prevalence of mental health concerns when they entered the study.¹² Whereas screenings for all three areas were required to be done prenatally among the majority of NFP programs, the majority of HFA programs did not require prenatal screenings in these areas with the exception of mental health. In general, local programs were less likely to have written protocols or policies related to supervisor consultation for working with families on substance use and intimate partner violence than on mental health.

Curriculum Use

All local programs use parenting curricula to guide home visitors in providing education on various topics to families. NFP provided local programs with guidelines for visits that support nurses in making assessments and meeting the needs of families.

¹¹This information was gathered in MIHOPE-Strong Start only from local programs recruited specifically for MIHOPE-Strong Start.

¹²The information provided here summarizes results presented in Appendix Table C.4. It is important to note that there are also other areas for which home visiting programs typically screen that are not shown in Appendix Table C.4. For example, both HFA and NFP required that local programs routinely screen for child developmental delay.

HFA allowed local programs flexibility in choosing curricula but specified that its local programs used evidence-informed curricula and provided examples of those commonly used. Both of these models' curricula generally focused on parenting and parent-child interaction. With respect to addressing prenatal health and birth outcomes, the two models had somewhat different approaches. HFA generally encouraged the use of the Great Beginnings Start Before Birth curriculum, which it offered to local programs along with training and support. Although it did not require local programs to use the curriculum, MIHOPE-Strong Start program manager survey data suggest that 17 out of 37 local HFA programs in the study did use it (results not shown). Local programs had the option of using a different curriculum as well; the three other most common curricula used by MIHOPE-Strong Start's local HFA programs were Partners for a Healthy Baby, San Angelo, and Growing Great Kids (results not shown). Local programs were responsible for their home visitors receiving the required training for these additional curricula. Regardless of the curriculum used, all local HFA programs could supplement it with additional outside materials. In contrast, NFP had a portfolio of materials for assessing maternal and child health and other outcomes. These materials include guidance on topics for clients, as well as instruction sheets, prompts, and tracking forms for use by the home visitors. Over 450 guidance materials were developed from evidence-based resources such as Centers for Disease Control and Prevention (CDC), American Pediatrics Association, the March of Dimes, and the American College of Obstetricians and Gynecologists (ACOG). In addition, these materials helped nurses to assess client needs and to aid and elicit client requests to determine which topics to discuss in visits. NFP also expected its home visitors to rely on their nursing training and education in prenatal and pediatric health.

Staff Development

Staff development can equip home visitors with the skills, knowledge, and reinforcement needed to deliver services. A foundational component of staff development is home visitor training, which may be conducted in a joint effort by the national office of the evidence-based model, the local programs, and state and local agencies. Training includes multiple daylong sessions that home visitors are required to attend prior to serving families as well as continuing training or professional development on varied topics throughout a home visitor's employment. In MIHOPE-Strong Start, local program managers reported that most or all of the home visitors were up to date on training. This is consistent with previous home visiting research.¹³ Information on the frequency and types of training home visitors received over the course of the study was not available for review in MIHOPE-Strong Start, although these features were described for the

¹³Boller et al. (2014).

programs that participated in the Mother and Infant Home Visiting Program Evaluation (MIHOPE) in the MIHOPE implementation research report.¹⁴

Aside from training, two key elements of staff development include one-on-one supervision and home visit observation. One-on-one supervision generally was a formal, scheduled session between a supervisor and home visitor. Observation of home visits refers to a supervisor directly observing an actual home visit as it is happening or in a video recording of the visit. Studies have shown that supervision is associated with decreased worker burnout, increased sense of personal accomplishment, fewer symptoms of depression among home visitors, and greater retention of families in home visiting programs.¹⁵ As a more direct way to build home visitors' skills, home visit observation is increasingly being used in local programs. A recent meta-analysis found that direct observation of home visits (either live or via video recording) is associated with larger program effects.¹⁶

The majority of local programs reported having policies in place for one-on-one supervision and observation of home visits.¹⁷ This is consistent with the expectations of the evidence-based models: NFP required weekly one-on-one supervision and home visit observation a minimum of once every four months, and HFA required weekly one-on-one supervision and that home visitors shadow direct service staff a minimum of twice per year. Correspondingly, almost all home visitors (92 percent) across both models reported having one-on-one supervision sessions at least weekly. Home visit observation was less common; in the year prior to the survey, about 13 percent of home visitors overall were never observed, with this being the case for higher percentages of HFA home visitors (17 percent) than NFP home visitors (8 percent). Across the two models, 50 percent of home visitors were observed one or two times, and 37 percent were observed three or more times.¹⁸

In terms of receiving supervisor guidance on particular content areas in the past 12 months, the majority of home visitors reported receiving guidance on prenatal health content from their supervisor once a month or more often, but almost one-third reported less frequent guidance (see Figure 3.1). There were few differences in the frequency of

¹⁴Duggan et al. (2018).

¹⁵Lee et al. (2013); Gill, Greenberg, Moon, and Margraf (2007); McGuigan, Katzev, and Pratt (2003).

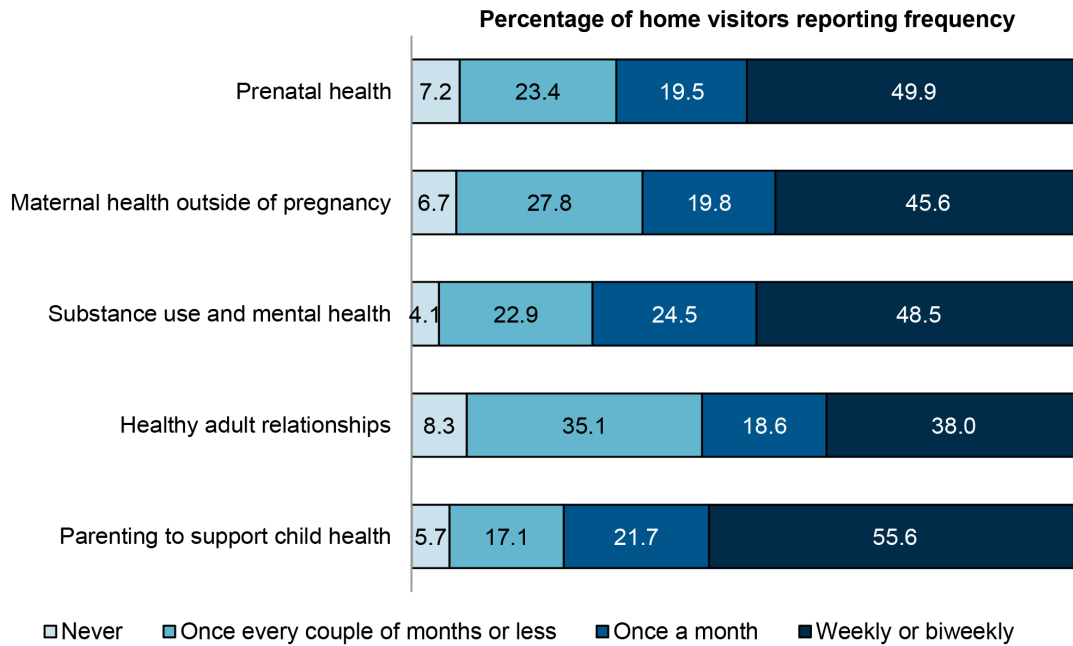
¹⁶Casillas, Fauchier, Derkash, and Garrido (2016).

¹⁷Results are shown in Appendix Table C.5.

¹⁸Results are shown in Appendix Table C.5.

Figure 3.1

Frequency of Supervisor Guidance Across Content Areas



SOURCES: Calculations based on data from the MIHOPE home visitor baseline survey and the MIHOPE-Strong Start home visitor survey.

NOTES: Sample size = 393 home visitors. Percentages are based on home visitors' reports of the frequency of supervisor guidance provided in particular content areas over the year prior to the survey. Full results are shown in Appendix Table C.6.

supervisor guidance between the evidence-based models.¹⁹ As one might expect, supervisors discussed these content areas somewhat more frequently with less experienced home visitors than with more experienced home visitors (results not shown).

Administrative and Clinical Sources of Support

Administrative forms of support. Administrative support tools are expected to promote fidelity to the evidence-based model by assisting local programs in delivering high-quality services.²⁰ Types of administrative support reported in MIHOPE-Strong

¹⁹Results are shown in Appendix Table C.6.

²⁰Fixsen et al. (2005).

Start included program monitoring, continuous quality improvement (CQI), and data management. Program monitoring included activities that systematically track service delivery across families, such as the provision of referrals and family participation. CQI was defined in MIHOPE-Strong Start as using data and information to inform performance and practice. Data management included the use of a management information system (MIS) and availability of staff members to support the collection, recording, and use of these data.

On indicators of administrative forms of support, the local programs in MIHOPE-Strong Start appear to have had adequate support in place.²¹ Nearly all local programs reported monitoring families' frequency of visits, number of referrals, retention in the program, and reasons for dropping out. Most local programs reported conducting one or more CQI activities in the year before the survey. However, fewer programs (about two-thirds) reported having dedicated staff members to assist with CQI activities. Nearly all local programs reported using a MIS for program monitoring and quality improvement.

Clinical forms of support. Prior research has found that access to consultative expertise in a content area is related to higher fidelity of implementation.²² In addition, studies have shown that the availability of mental health consultants is associated with improvements in home visitor knowledge and reductions in burnout and stress.²³ MIHOPE-Strong Start examined home visitors' access to clinical support from expert on-site professionals and professional consultants in key service areas.

About half of local programs reported that home visitors had access to at least one part- or full-time clinical staff member who worked on-site as part of a team of home visitors (results not shown). These professionals primarily included mental health therapists, social workers, health care workers, and early intervention specialists, based on availability.

There was also variation across local programs in home visitors' access to professional consultants, either internal or external to the local programs, to help them in facing unique or challenging situations with families. As illustrated in Figure 3.2, about one-third of programs had no access to professional consultants across the different service areas shown, such as prenatal health, substance use, mental health, and child health. About half or more of the local programs, however, reported having access to

²¹Lee, Crowne, Faucetta, and Hughes (2016). Also see Appendix Table C.7.

²²Fixsen et al. (2005).

²³Goodson et al. (2013); Boris et al. (2006).

consultants who provided direct services to families or direct services in addition to advice to staff across the different service areas. Patterns of access to consultants did not vary between the evidence-based models.

Home Visitor Perceptions of Program Support and Their Own Effectiveness

This section examines how home visitors perceived the strength of the forms of support described above in helping them in their own work. This section also describes home visitors' perceptions of their own levels of comfort and effectiveness in their roles.

The majority of home visitors reported that they felt supported by their local program's implementation system (support includes the usefulness of program strategies and tools, quality of supervision, and adequacy of training) in addressing maternal and infant health. As seen in Table 3.2, between 74 percent and 84 percent of home visitors reported that they felt supported by their local programs in improving health-related behaviors during pregnancy, in recognizing medical risk factors, and in helping mothers follow through on prenatal care providers' recommendations. Over three-quarters of home visitors felt supported in helping mothers start and continue to breastfeed, in improving child preventive care, and in improving maternal health outside of pregnancy. Most home visitors also reported feeling comfortable and effective in working with mothers to improve these behaviors.

Although some home visitors felt less comfortable and effective at addressing tobacco use, substance use, mental health, and intimate partner violence, the majority still reported feeling comfortable and effective working with mothers on these issues. NFP home visitors were more likely than HFA home visitors to report feeling supported, comfortable, and effective in improving health-related behaviors during pregnancy and in recognizing medical risk factors for poor birth outcomes. This may in part reflect the NFP home visitors' training and education in nursing.

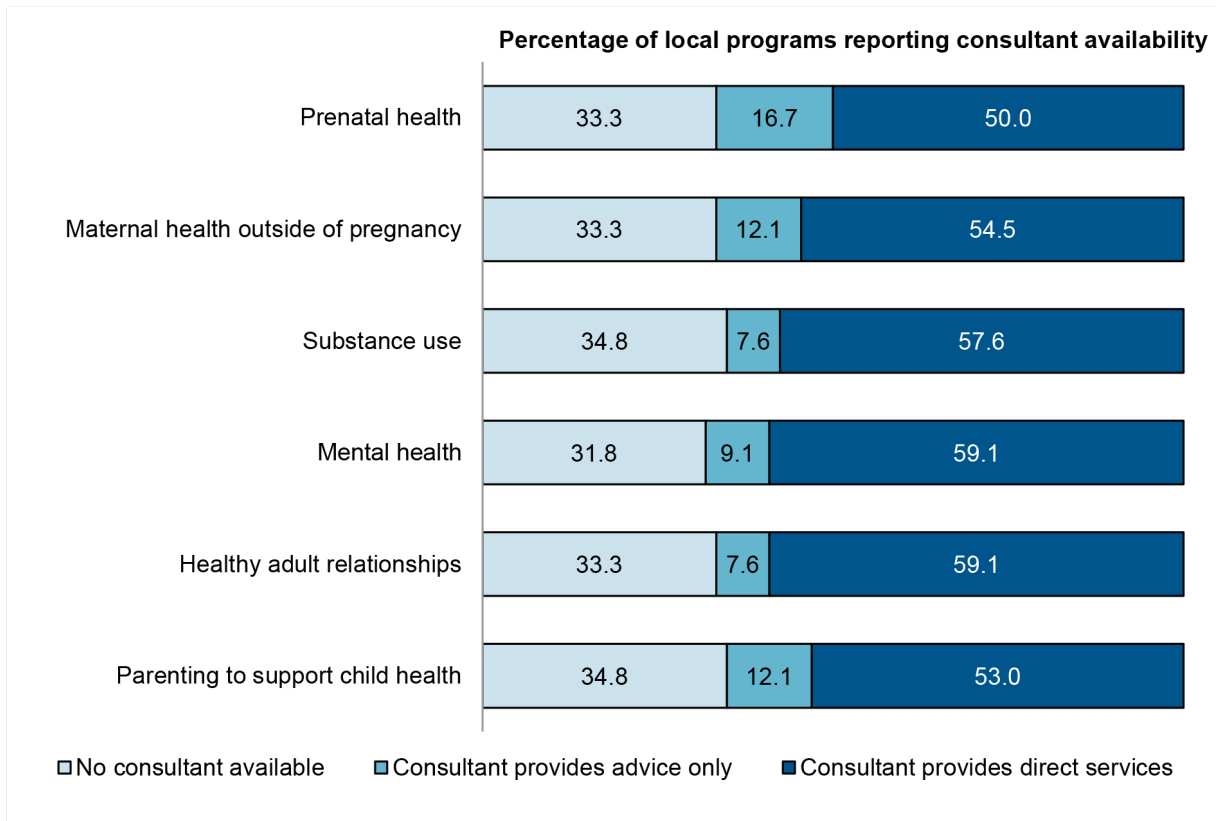
Caseload Size and Burnout Risk

Previous research has suggested that a lower caseload size for home visitors increases family engagement.²⁴ Research has also suggested that staff turnover and the associated higher caseloads may be disruptive to the quality of the home visitor-

²⁴Daro, McCurdy, Falconnier, and Stojanovic (2003).

Figure 3.2

Program Managers' Assessments of the Availability of Professional Consultants Across Service Areas



SOURCES: Calculations based on data from the MIHOPE program manager baseline survey and the MIHOPE-Strong Start program manager survey.

NOTES: Sample size = 66 program managers. The category of "consultant provides direct services" includes cases where the consultant also provides advice to home visitors. Full results are shown in Appendix Table C.8.

parent relationship and the overall quality of home visits.²⁵ At the time of the staff survey, the average caseload size of MIHOPE-Strong Start home visitors was 16 families, with NFP home visitors having slightly higher caseloads than home visitors in HFA programs, as seen in Table 3.3. Yet, overall, the average caseload size was generally lower than the maximum caseload size allowed by each model.²⁶

²⁵Vogel et al. (2011).

²⁶See Appendix Table C.9, which shows the limits the two models provide for family caseloads. At the time of the study, NFP specified a maximum of 25 families per home visitor; HFA took the frequency of visits into consideration and specified that caseload size should be a maximum of 15 families when visits were occurring weekly and no more than 25 families when visits were occurring less frequently.

Table 3.2
Home Visitors' Perceptions of the Implementation System at
Their Local Programs and Their Own Effectiveness

Outcome-Specific Category (%)	Home Visitors Are Supported by the Implementation System to Help Mothers... ^a			Home Visitors Are Comfortable and Effective Working to Help Mothers... ^b		
	Overall	HFA	NFP	Overall	HFA	NFP
<u>Maternal health and well-being</u>						
During pregnancy						
Improve health-related behaviors	79.8	75.2	85.0	87.9	84.5	91.7
Recognize medical risk factors for poor birth outcomes ^c	73.7	64.9	85.7	91.9	87.2	98.3
Follow through on prenatal care provider's recommendations ^c	83.5	81.6	86.0	94.8	93.5	96.5
Outside of pregnancy						
Improve health-related behaviors	76.6	73.2	80.7	84.5	84.5	84.5
Attend postpartum care appointments ^c	83.3	84.2	82.1	93.4	92.3	94.8
In general						
Space births	75.8	70.3	82.2	79.1	73.3	85.6
Reduce tobacco use	69.1	66.0	72.7	71.1	67.0	75.7
Recognize and address substance use	64.9	63.3	66.9	70.5	71.5	69.4
Recognize and address mental health	67.4	68.8	65.9	77.8	78.2	77.3
Recognize and address intimate partner violence	71.9	69.8	74.3	74.9	75.2	74.4
<u>Parenting to support child health</u>						
Start and continue breastfeeding	84.7	82.2	87.6	86.4	83.5	89.8
Improve child preventive care	83.5	85.6	81.1	92.5	93.7	91.2
Sample size	393	210	183	393	210	183

SOURCES: Calculations based on data from the MIHOPE home visitor baseline survey and the MIHOPE-Strong Start home visitor survey.

NOTES: HFA = Healthy Families America, NFP = Nurse-Family Partnership.

^aCombines home visitor ratings on the adequacy of their training, the availability of useful tools and strategies, and the receipt of positive and constructive supervisory feedback.

^bCombines home visitor ratings on how comfortable they feel talking with mothers and how effective they are in helping mothers in these areas.

^cQuestion was not asked in the MIHOPE home visitor survey. The sample was taken from MIHOPE-Strong Start home visitor survey data only. Overall sample size = 136 MIHOPE-Strong Start home visitors (78 HFA; 58 NFP).

Table 3.3
Home Visitors' Perceptions of Workload, Caseload Size,
and Burnout Risk

Home Visitor Perception	Overall	HFA	NFP
Number of families in home visitor's caseload ^a	16.1	14.1	18.4
Workload ^b (%)			
Too little time to do all the things program expects	22.7	19.7	26.1
Usually enough time	74.2	75.5	72.8
Often searching for things to do to fill up visit	3.1	4.8	1.1
Home visitor's rating of current caseload (%)			
Lighter than able to handle	27.3	25.7	29.1
About right	63.3	64.8	61.5
Heavier than able to handle	9.4	9.5	9.3
In the past 6 months, home visitor had caseload that was too much to handle effectively (%)			
None of the time	36.8	37.3	36.1
Nearly none or some of the time	46.5	47.4	45.6
About half of the time	6.4	7.7	5.0
Most to all of the time	10.3	7.7	13.3
Intends to leave position in next 12 months (%)	16.1	16.7	15.5
Sample size	393	210	183

SOURCES: Calculations based on data from the MIHOPE home visitor baseline survey and the MIHOPE-Strong Start home visitor survey.

NOTES: HFA = Healthy Families America, NFP = Nurse-Family Partnership.

^aStandard deviations: overall = 6.8; HFA = 6.0; NFP = 6.8. Range = 1-31.

^bThe response categories are constructed from a 7-point Likert scale.

Home visitor burnout has been associated with decreased time spent in visits.²⁷ In MIHOPE-Strong Start, several proxy measures for burnout risk among home visitors were examined: home visitors' perceptions that their workloads resulted in having too little time to do the things they were expected to do, their perceptions that their caseloads were more than they could handle, and their intentions to leave their positions in the next

²⁷Sharp, Ispa, Thornburg, and Lane (2003).

year. A little over 20 percent of home visitors felt that there was too little time to do all the things their programs expected of them. Only 10 percent of home visitors felt that their caseloads were more than they could handle effectively over the prior six months. Sixteen percent reported intending to leave their positions in the next year. Taken together, the majority of home visitors did not appear to be overburdened on these indicators.

Community Service Environment

Home visiting programs rely on close relationships with other providers in their community service environment both to help identify families interested in participating in home visiting and to make referrals to other providers. Therefore, it is important that local home visiting programs build and maintain strong relationships with community partners. The MIHOPE-Strong Start third annual report documented that the majority of local programs had a formal agreement with at least one type of organization to receive referrals *into* their home visiting program.²⁸ Slightly more than a third of local programs had a formal agreement with a central intake system, according to which referrals flow through one agency and are then distributed to the most appropriate service provider within the community. This arrangement was more common for local HFA programs than for NFP programs.²⁹

Home visiting programs also rely on providers in the community service environment to link families with services they may need that go beyond those provided by the home visiting program. Figure 3.3 shows that the vast majority of local programs had a service provider available in the community to which they could refer families in all service areas, including prenatal care and pediatric primary care. In this study, “availability” refers to the presence of a service provider to which local home visiting programs can refer families. This high availability of service providers is consistent with findings from a statewide evaluation of New Jersey.³⁰ In both this study and the New Jersey evaluation, the programs operated within primarily urban or suburban contexts; the availability of community service providers is likely to be more limited for programs operating in rural areas.

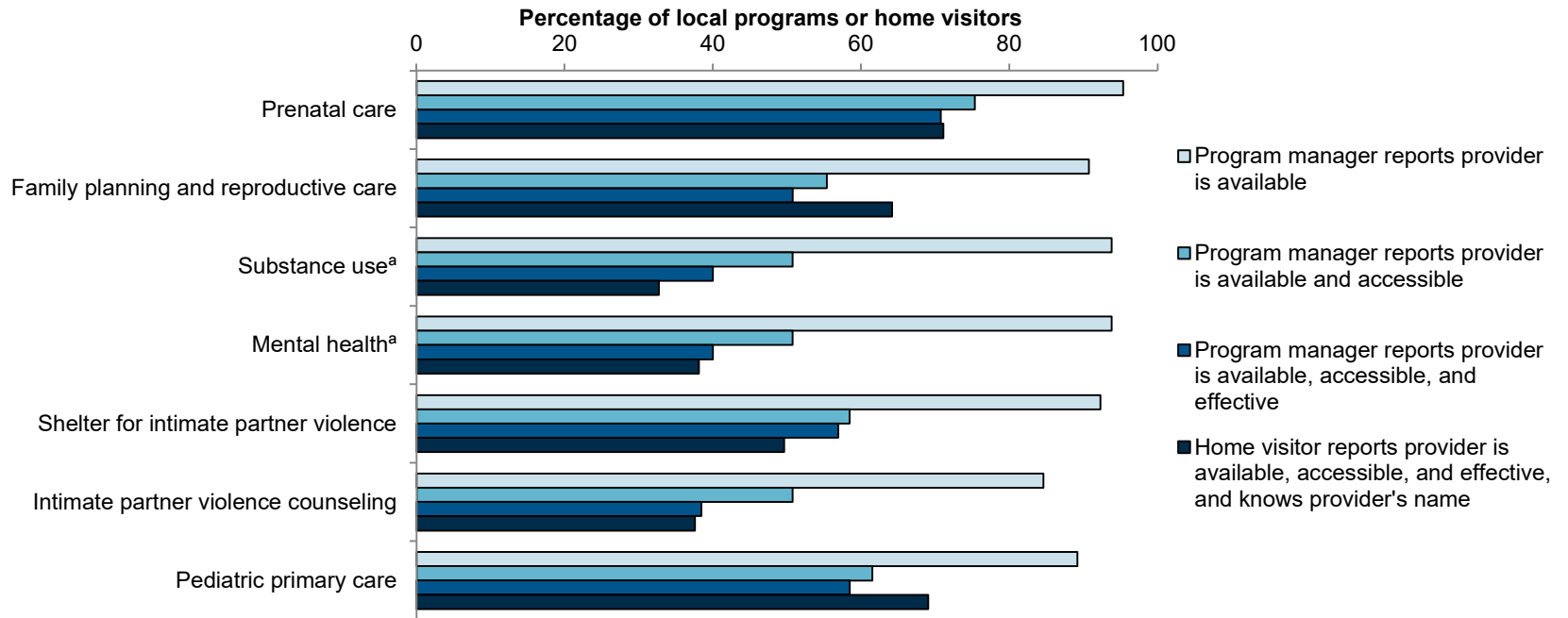
²⁸Lee, Crowne, Faucetta, and Hughes (2016).

²⁹For detailed results, see Appendix Table C.10.

³⁰Gustin et al. (2014).

Figure 3.3

Program Managers' and Home Visitors' Assessments of Community Service Provider Availability, Accessibility, and Effectiveness



SOURCES: Calculations based on data from the MIHOPE and MIHOPE-Strong Start community services inventories, the MIHOPE home visitor baseline survey, and the MIHOPE-Strong Start home visitor survey.

NOTES: Sample size = 65 program managers (one program manager was missing information on the measures shown) and 393 home visitors. See Appendix Table C.11 for full results.

All local program managers who responded to the community services inventories were included in the calculations of the service provider measures. Responses of "don't know" and "no" were treated as non-yes responses.

"Availability" refers to the presence of a service provider to which local home visiting programs could refer families, "accessibility" refers to the local program's perception of whether families faced difficulties in obtaining these services, and "effectiveness" refers to the local program's perception of how well a service provider delivered services to meet families' needs.

In the MIHOPE community services inventory, program managers were asked about two service providers for each service type. If at least one of these two providers was available to refer families and families experienced no access difficulties, then the local program was counted as having a service provider available and accessible (second bar). The same approach was used to count whether a program had a service provider that was available, accessible, and effective (third bar).

^aIn the community services inventories, substance use and mental health were combined; therefore, program managers' perceptions of service providers' availability, accessibility, and effectiveness for substance use and mental health are identical.

In addition to being available in the community, it is important for services to be both accessible to families and effective in meeting their needs. “Accessibility” refers to the local program’s perception of whether families face difficulties in obtaining the services (for example, difficulties emerging from the location of the provider or cost of services). “Effectiveness” refers to the local program’s perception that a service provider delivers services to meet the families’ needs to a satisfactory extent. For prenatal care, 71 percent of local programs reported that these services were available, accessible, and effective in their communities; for pediatric primary care, almost 60 percent reported their providers met all three criteria. Fewer than half of the local programs reported having available, accessible, and effective services for intimate partner violence counseling (39 percent) and treatment of substance use and mental health (40 percent). For the most part, these findings do not differ by evidence-based model.³¹

When asked for their perspectives, nearly all home visitors reported having all types of services available in their communities (results not shown), which is similar to the reports of program managers. If home visitors reported that a service provider was available and could name a particular service provider, they were then asked to rate that provider.³² As seen in Figure 3.3, home visitors’ ratings of service accessibility and effectiveness were highest for prenatal care and pediatric primary care (about 70 percent). Similar to the statements of program managers, home visitors’ reports were lowest for mental health (38 percent), intimate partner violence counseling (38 percent), and substance use treatment (33 percent).

Service Delivery

The prior section described how local HFA and NFP programs structured their services to support the work of home visitors. For the most part, local programs reported that they had support tools in place to guide, monitor, and support home visitors in their work. Furthermore, home visitors’ perceptions were aligned with these assessments, with most reporting that the implementation systems at their local program were strong and rating their own effectiveness levels as high. Together, these factors suggest that local programs were structured to provide services to families as intended by the models.

³¹For detailed results, see Appendix Table C.11.

³²Specifically, all home visitors were asked to rate the availability of community service providers across the areas shown in Figure 3.3. However, only those who were then able to name a specific provider in a service area were asked about their perceptions of the provider’s accessibility to families and effectiveness. Home visitors who were not able to name a provider are included in the denominator in Figure 3.3.

This section describes the actual services that program group families received during the study period. In particular, MIHOPE-Strong Start focused on three aspects of service delivery that are fundamental to understanding whether home visiting programs accomplish their goals: (1) the dosage to which a family is exposed (including the visit length and duration, frequency, and intensity of services); (2) the continuity of a family's home visitor; and (3) the content covered in home visits (such as the types of referrals that home visitors provide families to other services and topics they discuss in home visits). Both evidence-based models specified expectations regarding home visit dosage and content, and these expectations were used as a guideline for visit frequency. At the same time, each model emphasized the individual needs of the family in determining the level and content of services to offer them. Understanding the types and amounts of services that families received and the continuity of the home visitors delivering services provides important context for interpreting the impact results to be presented later in the report. This information does not, however, describe the quality of the home visiting services that were provided.

The primary source of information about service delivery for families recruited through MIHOPE-Strong Start is evidence-based model-, state-, and local-program-level MIS data. The primary source of information for families who were recruited through MIHOPE is the MIHOPE family service logs. The analytic sample was restricted to families who entered the study early enough to measure services through the week of the child's first birthday.³³ Data from both sources (MIS and logs) were pooled across programs to provide information on the duration, frequency, and intensity of visits with the families; home visitor continuity; and the content of visits. These data are available for 1,341 families and cover services delivered between November 2012 and December 2016.³⁴

³³To maximize the sample size while using a standard time frame for reporting dosage, the sample included families who had the potential to participate in home visiting services through the child's first birthday. This resulted in the exclusion of 187 families from the analysis. Another 27 families were excluded due to miscarriage and 17 program group families were excluded from data collection — 16 families from a program that did not have an MIS at the time data collection activities began and 1 family who could not be matched to the MIS. See Appendix A on data sources and sample sizes for further detail.

³⁴The number of families includes program group families who received no visits and, thus, had no MIS or log data on services to provide. Data from programs in MIHOPE-Strong Start started in mid-June 2014 and ran through December 2016. Data from programs recruited through MIHOPE include family service logs collected from November 2012 through July 2016. For each individual family, the observation period — or duration of participation — recorded within these data collection windows began with the week of the first home visit (enrollment) and ended with the week of the last home visit.

Home Visiting Dosage

Some families who initially accept home visiting services may not ever receive any visits. Previous studies have found that between 78 percent and 88 percent of families who agree to enroll in services actually do enroll and receive at least one home visit.³⁵ In MIHOPE-Strong Start, 86 percent of families who were assigned to the program group enrolled and received at least one home visit, even though all families initially were interested in home visiting and were eligible to receive services (see Table 3.4).³⁶

The remainder of this section presents results for the 1,154 program group families who received at least one home visit, in accordance with how both evidence-based models defined a family's enrollment in the program. The observation period spans the time from the family's first home visit through the time of their last home visit, up to and including the week of the child's first birthday.³⁷ For all but 12 families (1 percent), the first home visit occurred during pregnancy.³⁸

MIHOPE-Strong Start measured families' dosage of home visiting services in four ways: (1) how long the family participated in services (duration); (2) the frequency of visits; (3) the intensity of visits (visit rate and the percentage of families receiving higher-than-average dosage); and (4) visit length. Most measures of dosage are reported separately for services received from pregnancy until birth and for services received during the 12 months after birth because only the former would influence birth outcomes.

³⁵Wagner et al. (2003); Duggan et al. (1999).

³⁶This means that 14 percent of families assigned to the program group never received a home visit. There are various reasons why an interested family may have ultimately not enrolled in program services. For example, a family might have moved out of the service area; a mother might have changed her mind about wanting to, or having time to, participate in services; or the family's contact information may have changed, preventing the local program staff from being able to schedule the first visit. In looking at the length of time between a family entering the study and their first home visit, there were fewer than 20 families with a very long delay (more than 12 weeks). While the exact reasons for the lags are unknown, most of these mothers either changed addresses while enrolled in the study (which may or may not have occurred after home visiting was initiated) or cancelled multiple home visiting appointments prior to their first home visit.

³⁷See Appendix Table C.12 for dosage findings spanning the period from the date of random assignment through the week of the child's first birthday, among families who received visits. Appendix Table C.13 shows dosage findings using the full sample of program group families, including families with no visits.

³⁸These 12 women met the study criteria of being no more than 32 weeks pregnant at the time of random assignment but did not receive their first home visit until after giving birth.

Table 3.4

Home Visiting Participation Among Program Group Families

Service Delivery Measure	Overall	HFA	NFP
Ever received a home visit (%)	86.1	83.6	87.4
During pregnancy	85.2	81.2	87.3
After birth until child is 12 months old	68.0	64.8	69.7
Sample size	1,341	469	872

SOURCES: Calculations based on data from the MIHOPE family service logs and management information systems.

NOTES: HFA = Healthy Families America, NFP = Nurse-Family Partnership.

The sample includes all program group families, including those who never had a visit, for whom information was available; who entered the study early enough for services to be measured through the week of the child's first birthday; and who did not experience a miscarriage.

There is little empirical evidence on which aspects of service delivery, or which thresholds of those aspects, are needed to create change in participant outcomes. Some correlational research suggests that a range of home visiting outcomes could be affected by the extent of a family's exposure to the program, as measured via the duration and frequency of services.³⁹ For example, a literature review of randomized home visiting studies found that a service duration of at least one year coupled with four or more visits per month is associated with positive child and family outcomes.⁴⁰ Another review of the literature found an association between the amount of home visiting and improved child cognitive outcomes, but no such effect was found for the other domains examined, including child abuse, parenting behaviors, and maternal life course.⁴¹ The influence of dosage during pregnancy on prenatal health and birth outcomes has been less studied. One HFA study, using a nonrandom assignment design, that enrolled women prior to 26 weeks of gestation found that the receipt of eight or more home visits during pregnancy was associated with a reduced likelihood of preterm birth,⁴² and the

³⁹Korfmacher, Kitzman, and Olds (1998); Lee et al. (2009); Lyons-Ruth and Melnick (2004); Nievar, Van Egeren, and Pollard (2010); Raikes et al. (2006).

⁴⁰Kahn and Moore (2010).

⁴¹Sweet and Appelbaum (2004).

⁴²Goyal et al. (2013). Because the nonrandomized study used a retrospective cohort design and lacked a comparison group, the MIHOPE-Strong Start research team did not include these results in the review of the prior literature on HFA and NFP programs and their effects on birth outcomes, which was summarized in Chapter 1 and again in Chapter 4.

HFA New York randomized controlled trial (RCT) on birth outcomes found that reductions in low birth weight were stronger among program group women who received seven or more home visits during pregnancy.⁴³ Exposure to the program earlier in pregnancy may be particularly important, as it provides a greater opportunity for the program to influence birth outcomes.

Duration and timing of visits. As shown in Table 3.5, on average, families participated in home visiting services for 10.8 months over the observed period (including during pregnancy and the year after birth). The average time between random assignment and receipt of the first home visit was 2.3 weeks and the median length of time was one week, which suggests that the majority of families who received at least one home visit began home visiting shortly after study entry (results not shown).

Families served by NFP programs participated for longer durations (11.6 months) than those served by HFA programs (9.2 months). These differences partly reflect longer durations of participation during the prenatal period for NFP families (NFP = 4.3 months; HFA = 2.9 months) due to the earlier timing of their first visits during pregnancy (NFP = 17.6 weeks' gestation; HFA = 23.7 weeks' gestation), as shown in Appendix Table C.12. This aligns with NFP model expectations, whereby all women must have enrolled by the twenty-eighth week of pregnancy, but local programs were strongly encouraged to enroll women as early as possible in the pregnancy. Families served by HFA could enroll at any point in their pregnancy (although MIHOPE-Strong Start only enrolled HFA applicants who were up to 32 weeks of gestation).

Table 3.5 shows that despite differences in when the first visit during pregnancy occurred, the percentage of families still enrolled at the time of the child's birth was similar across the two models (about 81 percent overall). These rates dropped by the time of the child's first birthday, with about half of families who received at least one home visit across the two models still enrolled 12 months after birth. Consistent with prior research, these findings show that a considerable fraction of families did not participate in services until the child's second or third birthday, contrary to NFP's and HFA's respective expectations.⁴⁴

⁴³Lee et al. (2009).

⁴⁴Duggan et al. (1999); Duggan et al. (2007); Korfmacher, Kitzman, and Olds (1998); McFarlane et al. (2010); O'Brien et al. (2012). HFA expects families to receive home visits through the child's third birthday (and up until the fifth birthday); NFP expects families to receive them until the child's second birthday (see details in Table 1.1).

Table 3.5
Duration of Participation, Visit Frequency, and Visit Rates
Among Families with Visits

Service Delivery Measure	Overall	HFA	NFP
<u>Duration of participation</u>			
Months of participation in home visiting, over entire study period ^a	10.8	9.2	11.6
During pregnancy	3.8	2.9	4.3
After birth until child is 12 months old	7.0	6.3	7.3
Family still enrolled...			
At child's birth ^b (%)	80.9	79.3	81.8
When child is 12 months old ^c (%)	48.2	38.5	53.1
<u>Visit frequency</u>			
Number of visits expected, over entire study period ^d	43.2	46.0	41.8
During pregnancy	11.1	7.8	12.8
After birth until child is 12 months old	32.1	38.2	29.0
Number of visits received, over entire study period ^e	21.2	23.5	20.1
During pregnancy	7.7	6.2	8.5
After birth until child is 12 months old	13.5	17.3	11.6
Over entire study period, families with... (%)			
1-11 visits	30.8	34.4	28.9
12-23 visits	23.6	18.1	26.4
24-35 visits	29.5	17.6	35.7
36 or more visits	16.1	29.8	9.1
During pregnancy, families with... (%)			
0-4 visits	27.1	41.3	19.8
5-9 visits	37.4	38.3	37.0
10-14 visits	29.5	15.3	36.9
15 or more visits	5.9	5.1	6.3
After birth until child is 12 months old, families with... (%)			
0-4 visits	32.4	34.9	31.1
5-9 visits	9.5	6.1	11.3
10-14 visits	12.2	8.4	14.2
15 or more visits	45.8	50.5	43.4
Over entire study period, families who received at least half of expected visits (%) ^f	52.6	50.0	53.9
During pregnancy	77.1	77.6	76.9
After birth until child is 12 months old	45.1	44.6	45.3

(continued)

Table 3.5 Duration of Participation, Visit Frequency, and Visit Rates (continued)

Service Delivery Measure	Overall	HFA	NFP
Visit rate			
Number of visits per month, over entire study period ⁹	2.0	2.3	1.8
During pregnancy	2.0	2.0	2.0
After birth until child is 12 months old	1.5	2.0	1.3
Over entire study period, proportion of families with... (%)			
0.9 or fewer visits per month enrolled	4.1	1.8	5.2
1.0-1.9 visits per month enrolled	51.5	29.1	63.0
2.0-2.9 visits per month enrolled	34.7	50.3	26.8
3.0 or more visits per month enrolled	9.7	18.9	5.0
Higher than average level of services (%)			
Enrollment until child's birth and receipt of at least half of expected visits during pregnancy	74.2	73.5	74.5
Enrollment until child is 12 months old and receipt of at least half of expected visits over entire study period	43.8	37.0	47.4
Sample size	1,154	392	762

SOURCES: Calculations based on data from the MIHOPE family service logs and management information systems.

NOTES: HFA = Healthy Families America, NFP = Nurse-Family Partnership.

The sample includes program group families for whom information was available who had at least one home visit, who entered the study early enough for services to be measured through the week of the child's first birthday, and who did not experience a miscarriage.

Twelve families whose first visit occurred after birth are included in the pregnancy period calculations, and 242 families who received visits only during the pregnancy period are included in the year-after-birth calculations. They contribute "0" visits to the respective time period.

^aStandard deviations: overall = 6.3; HFA = 6.0; NFP = 6.3. Range = 0.3 months to 20 months. Prenatal duration and after-birth duration may not add up to total duration due to rounding.

^bA family is considered still enrolled at the child's birth if the family received at least one visit during pregnancy and received a home visit four weeks before the child's birth, the week of the child's birth, or any time after the child's birth.

^cA family is considered still enrolled when the child is 12 months old if the family received a home visit two weeks before the child's first birthday, the week of the child's first birthday, or any time after the child's first birthday.

^dStandard deviations: overall = 3.8; HFA = 3.6; NFP = 3.0. Range = 37 visits to 57 visits.

^eStandard deviations: overall = 14.7; HFA = 18.9; NFP = 11.7. Range = 1 visit to 177 visits.

^fFor analysis purposes, the study team used the following assumptions to identify a specific number of expected visits for each family by model: HFA was based on an expectation of visits every other week in the pregnancy period, weekly visits for the first six months following the child's birth, and then visits every other week until the child's first birthday. NFP was based on an expectation of weekly visits for the first four weeks in the pregnancy period, visits every other week until the child's birth, weekly visits for the first six weeks following the child's birth, and then visits every other week until the child's first birthday. In addition, a minimum of four prenatal visits for HFA and eight prenatal visits for NFP were expected. The number of visits expected for a given family could be higher or lower than the "typical" expectation used in these calculations, depending on when the family enrolled and the identified strengths and risk factors of the client.

⁹Calculated by dividing the number of visits received through the week of the child's first birthday by the family's duration of participation. Standard deviations: overall = 0.8; HFA = 0.9; NFP = 0.6. Range = 0.5 visits per month to 12 visits per month.

Visit frequency. Regular contact with families was a main focus of both evidence-based models. The expected frequency of visits varied depending on family risk and need, child age, or time since enrollment. Both evidence-based models explicitly allowed adjustments of the visiting schedule for specific families and delegated such decisions to the local program's home visiting staff. The MIHOPE-Strong Start research team conferred with the evidence-based model developers to understand the number of visits expected during a typical family's first year of enrollment in a local program for the purpose of these analyses. The intended visit frequency for each family was calculated based on the gestational age at enrollment and the following model expectations:

- **HFA:** Visits biweekly⁴⁵ after prenatal enrollment⁴⁶ and until the child's birth, weekly for the six months following the child's birth, and then every other week until the child's first birthday.
- **NFP:** Visits weekly for the first four weeks of enrollment,⁴⁷ every other week until the child's birth, weekly for the first six weeks following the child's birth, and every other week until the child is 12 months old.⁴⁸

As shown in Table 3.5, on average, families were expected to receive 43 visits over the entire study period, with 11 visits occurring during pregnancy and 32 visits occurring between the child's birth and first birthday. Overall, families received an average of 21 visits — close to 8 during pregnancy and 13.5 in the year after birth. As documented in previous studies of HFA and NFP, families received about half of expected visits on average.⁴⁹

⁴⁵For purposes of the analysis in this chapter, a biweekly visit schedule was assumed during pregnancy, as this was the recommended visit schedule from HFA at the time program group families in the study received home visiting services. As of this report's writing, HFA specifies weekly or bi-weekly visits during pregnancy.

⁴⁶Some HFA families received their first home visit later than the 32-week gestation date required by the study. For purposes of the analysis, it was assumed that enrollment occurred at 32 weeks for these families. This amounts to the expectation of a minimum of four visits during pregnancy for these families.

⁴⁷Some NFP families received their first home visit later than the 28-week gestation date required by the model. For purposes of the analysis, it was assumed that enrollment occurred at 28 weeks for these families. This amounts to the expectation of a minimum of eight visits during pregnancy for these families.

⁴⁸NFP introduced the Strength and Risk (STAR) framework in 2015. Using the STAR framework, after pregnancy, the frequency of visits may change based on assessment of the client's strengths and risks.

⁴⁹Riley et al. (2008); Korfmacher, Kitzman, and Olds (1998); Olds et al. (1997).

Families served by NFP, on average, received more visits during pregnancy (8.5 visits) than those served by HFA programs (6.2 visits). These differences are reflective of longer durations of participation during pregnancy for NFP families. The number of home visits received during pregnancy across both models in this study is similar to the frequency of home visits during pregnancy reported in previous trials of both NFP (6.5 visits to 8.6 visits) and HFA (7 visits).⁵⁰

There was considerable variation in the number of visits families ultimately received. On one end of the spectrum, 27 percent of families received fewer than 5 visits during pregnancy. On the other end, about 6 percent of families received 15 or more visits during pregnancy.

The study team compared the number of visits each family received with the number of visits expected by the respective model, as detailed above. For certain families, the number of visits expected could be higher or lower than the typical expectation used in the MIHOPE-Strong Start analyses, depending on the identified strengths and risks of the client. A dichotomous indicator was created to show whether families received at least half of the number of visits typically expected over the entire study period, during pregnancy, and from the child's birth to the child's first birthday. About 50 percent of families received at least half of the visits expected by their model over the entire study period, and these percentages were similar for families in HFA programs and families in NFP programs. Only 24 percent of families received 75 percent of expected visits overall (results not shown). These numbers are low compared with the findings of a study of HFA and NFP programs in New Jersey⁵¹ and the Evidence-Based Home Visiting (EBHV) study, which looked at HFA, NFP, and three other evidence-based models.⁵² The study of HFA and NFP programs in New Jersey found that two-thirds of families received at least half of expected visits, and the EBHV study reported that 44 percent of families received 80 percent of expected visits.⁵³ Those studies, however, covered shorter time periods (6 and 12 months, respectively, including the prenatal period) and both calculated visit expectancy differently from MIHOPE-Strong Start, so their specific estimates are not directly comparable to those of this study.⁵⁴

⁵⁰Lee et al. (2009); Korfmacher, O'Brien, Hiatt, and Olds (1999); Kitzman et al. (1997); Olds et al. (1997).

⁵¹Duggan et al. (2015).

⁵²Boller et al. (2014).

⁵³Boller et al. (2014); Duggan et al. (2015).

⁵⁴In the New Jersey report (Duggan et al., 2015), the visit expectancy for HFA was calculated based on the number of days spent on various service levels and the visit frequency assigned to those levels. For NFP families, the report calculated visit expectancy based on the visit schedule according

In MIHOPE-Strong Start, 77 percent of families received at least half of the expected number of visits during pregnancy. Sixty percent of families received three-fourths of the expected visits during pregnancy (results not shown), which is much higher than what was found in the New Jersey study and in line with results from the EBHV study. About 45 percent of families received at least half the expected number of visits in the year after birth. This is not surprising given that a large majority of families remained enrolled through the child's birth, but only about half remained enrolled through the child's first birthday.

Visit rate and higher-than-average service receipt. In this study, duration of participation and visit frequency were combined to examine the number of home visits families received per month (visit rate) and the number of families who received higher-than-average levels of home visiting services (based on the duration of participation and percentage of visits received in reference to the model's expected number of home visits). The visit rate is an indicator of the intensity of services, which has been standardized as a monthly measure across families regardless of their duration. On average, over the study time period, families were visited twice per month enrolled. Families served by each model were visited with the same frequency while pregnant (twice per month).

Families who received a higher-than-average level of home visiting services were defined as those who were enrolled for a meaningful period of time *and* had frequent visits during that time. A meaningful period of time was examined across two overlapping time periods — from pregnancy until the child's birth and from pregnancy until the child's first birthday (the entire study period). Visit frequency was defined in relation to each family's gestational age at enrollment and each model's guidelines, as specified previously. Families were considered to have received a higher-than-average level of services if they remained enrolled:

to the number of days the mother was pregnant and the visit schedule based on the number of days during the postnatal period. The EBHV study used a standard model-specific visit expectancy schedule to calculate the expected number of visits (Boller et al., 2014). MIHOPE-Strong Start calculated visit expectancy based on the number of weeks the mother was pregnant and a 52-week period after the birth and the visit schedule assigned to those periods. As noted earlier, the study consulted the national models to determine the expected visit schedule. The time period for visit expectancy in MIHOPE-Strong Start ranged from 14.0 months to 20.5 months depending on how early in pregnancy a family enrolled.

- until the child's birth *and* they received at least half of the expected visits for their model from the time of enrollment through the child's birth,⁵⁵ or
- until the child's first birthday *and* they received at least half of the expected visits for their model from the time of enrollment through the child's first birthday.⁵⁶

These measures of higher-than-average service receipt are conceptualized similarly to that of the New Jersey study of HFA and NFP programs.⁵⁷

Among families who received at least one visit, 74 percent received a higher-than-average level of services in the prenatal period, as shown in Table 3.5, and there were no differences across the two models. Fewer than half of families (44 percent) received higher-than-average home visiting services from enrollment to the child's first birthday. Compared with families enrolled in HFA programs, a larger percentage of families enrolled in NFP programs received a level of services that was higher than average from enrollment to the child's first birthday. This is largely due to the fact that a larger percentage of NFP families than HFA families stayed enrolled in services through the child's first birthday.

Visit length. Visits lasted for well over an hour on average — 73 minutes in the prenatal period and 71 minutes in the year-after-birth period (results not shown). Visits were longer for NFP families than for HFA families in both the prenatal and the postnatal periods on average (78 minutes versus 63 minutes prenatally; 76 minutes versus 62 minutes postnatally). These figures are well within the model standards of a minimum 60-minute visit for HFA and a 60- to 90-minute visit for NFP. These results are also consistent with those of previous studies of HFA and NFP.⁵⁸

Home Visitor Continuity

The evidence-based home visiting models in MIHOPE-Strong Start value a strong, ongoing working relationship between the family and home visitor. The continuity

⁵⁵A family was considered enrolled at the child's birth if the family received at least one visit during pregnancy and received a home visit within four weeks before the week of the child's birth or any time after that point.

⁵⁶A family was considered enrolled when the child was 12 months old if the family received a home visit two weeks before the week of the child's first birthday or any time after that point.

⁵⁷Latimore et al. (2017).

⁵⁸Boller et al. (2014); James Bell Associates (2010); Korfmacher, O'Brien, Hiatt, and Olds (1999).

of a family's home visitor helps to build a strong working relationship, and the quality of the relationship between them has been found to be an important factor in the amount of services received.⁵⁹ Previous research has suggested that families whose home visitors don't stay with the program for the duration of the families' participation remain enrolled for a shorter amount of time and receive fewer home visits than families who maintain a single home visitor until the child's first birthday.⁶⁰ In addition, previous NFP trials have suggested that home visitor turnover may be associated with program impacts.⁶¹

MIHOPE-Strong Start assessed home visitor continuity in two ways: (1) the number of home visitors⁶² to visit a family over the course of the family's entire participation period in the study, and (2) the Bice-Boxerman Continuity of Care Index (limited to families with at least four home visits).⁶³ The Continuity of Care Index was developed within the primary health care field, which has studied the benefits of an ongoing relationship between providers and patients, suggesting this type of relationship is an attribute of high-quality primary care.⁶⁴ The Continuity of Care Index measures the concentration of visits with various providers. In this study, it was used to measure the number of home visitors a family saw and the number of visits each home visitor conducted. Higher continuity scores (values closer to 1) reflect a larger number of visits concentrated within a smaller number of home visitors.⁶⁵

Home visitor continuity in this study was high overall. Over three-quarters of families who received at least one visit received all of their visits from a single home visitor, as shown in Table 3.6. Moreover, average home visitor continuity — which adjusts for the total number of visits — was extremely high for families with at least four home visits (Continuity of Care Index = 0.9).

⁵⁹Korfmacher, Green, Spellmann, and Thornburg (2007); Daro et al. (2005).

⁶⁰O'Brien et al. (2012).

⁶¹Olds et al. (1999).

⁶²This could include a staff member not registered as a home visitor (for example, a supervisor or specialist).

⁶³Bice and Boxerman (1977). The Bice-Boxerman Continuity of Care Index uses a patient's number of physicians and number of visits to determine the dispersion of their visits, resulting in a value between 0 and 1. In MIHOPE-Strong Start, the research team limited the use of this index to families with at least four visits, based on the belief that the concept (and calculation) of continuity is only meaningful among families who engage in home visiting for more than a few visits.

⁶⁴Bice and Boxerman (1977); Institute of Medicine (1996).

⁶⁵Christakis et al. (2000).

Table 3.6**Home Visitor Continuity Among Families with Visits**

Service Delivery Measure	Overall	HFA	NFP
Number of home visitors to visit a family (%) ^a			
One home visitor	77.3	75.0	78.5
Two home visitors	19.0	20.2	18.4
Three or more home visitors	3.7	4.8	3.1
Continuity of care as experienced by families ^b	0.9	0.9	0.9
Sample size	1,154	392	762

SOURCES: Calculations based on data from the MIHOPE family service logs and management information systems.

NOTES: HFA = Healthy Families America, NFP = Nurse-Family Partnership.

The sample includes program group families for whom information was available who had at least one home visit, who entered the study early enough for services to be measured through the week of the child's first birthday, and who did not experience a miscarriage.

^aThis number may include staff members not registered as a home visitor, such as a supervisor or specialist.

^bThis outcome was measured using the Continuity of Care Index (Bice and Boxerman, 1977). It was limited to program group families with at least four home visits (overall = 996; HFA = 319; NFP = 677). Standard deviations: overall = 0.2; HFA = 0.2; NFP = 0.2. Range = 0.3 to 1.

Home Visiting Content

Both referrals made by home visitors to other community services and topics discussed during home visits are primary mechanisms through which home visiting can affect birth, infant health, and health care use outcomes. The evidence-based models specify procedures for recognizing the need for professional assistance and for referring families to needed community services. As described earlier, the local programs of both HFA and NFP in this study expected home visitors to assess the need for and receipt of prenatal care, and most local programs required formal screenings for mental health, substance use, and intimate partner violence. Because NFP home visitors are nurses, they also have the option of monitoring vital symptoms (such as blood pressure) and preterm labor signs.

Local programs in MIHOPE-Strong Start also specified how to respond to an identified need or a positive screening result, such as by referring a family for further evaluation. The provision of education and support across a variety of topics is another of the main activities carried out by home visitors, but this section primarily summarizes information on the referrals provided to participating families. Although MIHOPE-Strong

Start had limited access to MIS data on the topics addressed in home visits, it did have access to comparable MIS and MIHOPE family service log data on referrals. When relevant, findings on the topics discussed during home visits are also described for the subsample of families with this information available.⁶⁶

Referrals during pregnancy. Table 3.7 shows the percentage of families who received referrals for services related to maternal and infant health and well-being during pregnancy among families who received at least one home visit.⁶⁷ Prenatal health was the most common category for which referrals were provided to families (42 percent), with higher referral rates observed among families in NFP programs than HFA programs. The percentage of families receiving referrals for prenatal health is somewhat surprisingly high, given that, as described earlier in Chapter 2, most of the sample appears to have had a usual source of care and had already accessed prenatal care in the first trimester (among those who enrolled in the study by the second or third trimester). Though the reasons for referrals to prenatal health services are unknown (as such information is not available), at the very least, home visitors appear to have identified some gaps in prenatal health care services throughout the pregnancy period for program group women who had at least one home visit.

During pregnancy, 35 percent of families received referrals for public assistance (which could include health insurance) and 22 percent received referrals for breastfeeding, infant feeding, or nutrition. About 15 percent of families received referrals for mental health and stress. Referrals for tobacco and substance use and intimate partner violence were uncommon. On average, families received referrals in two different service categories during pregnancy.

Referrals after birth. Table 3.7 also shows the percentage of families who received referrals across service areas in the year after birth. About 30 percent of families received a referral related to child health and safety in the year after birth. Nearly 30 percent also received at least one referral for public assistance. In the period after birth, rates of referrals for breastfeeding, infant feeding, and nutrition were similar to referral

⁶⁶The information available on topics discussed during home visits, taken from the MIS data on families in NFP programs, was not collected in a way that is comparable to the rest of the sample. Therefore, the study team was not able to use MIS data related to topics discussed for the families in NFP programs who were recruited through MIHOPE-Strong Start. However, families in NFP programs who were recruited through MIHOPE have comparable information on topics discussed during visits, which is available through the MIHOPE service delivery logs. See Appendix Table C.2 for additional information on home visit topics among those families for whom this information was collected similarly across data sources.

⁶⁷Appendix Table C.13 presents referral information for all families, including those with no visits.

Table 3.7
Referrals Made Among Families with Visits

Referral Service Categories	During Pregnancy			Year After Birth		
	Overall	HFA	NFP	Overall	HFA	NFP
Number of unique category referrals provided ^{a,b} (mean)	2.1	1.9	2.2	2.0	1.7	2.2
Provision of at least one referral in category (%)						
Prenatal health	41.6	31.1	47.0	NA	NA	NA
Maternal health outside of pregnancy ^c	14.9	7.4	18.8	17.6	7.7	22.7
Family planning and birth spacing	6.2	7.9	5.4	17.3	13.8	19.2
Tobacco and substance use	4.8	6.6	3.8	1.9	1.8	2.0
Mental health and stress	15.3	17.3	14.2	18.0	19.1	17.5
Intimate partner violence	4.2	5.6	3.5	5.9	6.9	5.4
Breastfeeding, infant feeding, and nutrition	21.5	18.6	23.0	19.0	15.8	20.6
Child health and safety	NA	NA	NA	28.8	19.6	33.5
Public assistance, including health insurance	35.0	28.1	38.6	29.3	23.7	32.2
Housing	17.2	19.9	15.9	16.8	17.3	16.5
Sample size	1,154	392	762	1,154	392	762

SOURCES: Calculations based on data from the MIHOPE family service logs and management information systems.

NOTES: HFA = Healthy Families America, NFP = Nurse-Family Partnership, NA = not applicable.

The sample consists of program group families for whom information was available, who had at least one home visit, who entered the study early enough for services to be measured through the week of the child's first birthday, and who did not experience a miscarriage.

Referrals occurring the week of the child's birth are considered referrals during pregnancy.

Twelve families whose first visit occurred after birth are included in the pregnancy period calculations, and 242 families who received visits during the pregnancy period only are included in the year-after-birth calculations. They contribute "0" referrals to the respective time period.

^aThere were 10 possible referral categories during the pregnancy period and year after birth, including "other."

^bPregnancy period standard deviations: overall = 1.8; HFA = 1.9; NFP = 1.8. Pregnancy period range = 0 referrals to 9 referrals. Year-after-birth period standard deviations: overall = 2.1; HFA = 2.1; NFP = 2.1. Year-after-birth range = 0 referrals to 9 referrals.

^cReferrals for maternal health outside of pregnancy should be unrelated to prenatal care, family planning, reproductive health care, or childbirth education. After-birth referrals for maternal health outside pregnancy would include referrals for postpartum checkups.

rates in the prenatal period. Referrals for mental health and stress in the year after birth were also similar to what they were during pregnancy. In the year after birth, about 17 percent of families received referrals for family planning and birth spacing, which is, not surprisingly, higher than what was found during pregnancy. On average, families received referrals in two different service categories during the year after birth.

In addition to referrals that are directly related to maternal and infant health, home visitors could have provided referrals to a number of other services. In fact, half of the families received at least one referral to a category not reported in Table 3.7. Other common referral categories include job training, concrete goods/materials/support, adult education, and child care.

Topics discussed during pregnancy and after birth.⁶⁸ Nearly all families (96 percent) received at least one home visit during pregnancy in which prenatal health was discussed. In addition, 87 percent of the home visits that families received during pregnancy included discussions of prenatal health (results not shown). While most families (nearly three-fourths) had at least one home visit during pregnancy in which mental health and stress was discussed (with 38 percent of visits during pregnancy including discussions of the topic [results not shown]), prenatal health was discussed more frequently. About half of families received a prenatal visit in which tobacco and substance use was discussed, and less than a third of families had a prenatal visit in which intimate partner violence was discussed.

Three-fourths of program group families who had at least one visit discussed child health and safety with their home visitor in the year following birth. Child health and safety was discussed in over half of the home visits that families received after birth (results not shown). More families during pregnancy than following birth had a visit in which mental health and stress, tobacco and substance use, or intimate partner violence was discussed.

Explaining Variation in Service Delivery

Although the average family in MIHOPE-Strong Start received a similar level of services as average families in prior studies, MIHOPE-Strong Start also found that families in the study varied in the intensity and types of services they received. This section describes how the characteristics of families, home visitors, and local programs are independently

⁶⁸Information on the percentage of families who ever discussed a particular topic during pregnancy and the child's first year is taken from data on the 859 families shown in Appendix Table C.14. Sample sizes vary slightly based on the specific topic due to missing information.

related to the services received.⁶⁹ The specific aspects of service delivery examined are two interrelated measures of dosage:

- **frequency**, or the number of home visits received during pregnancy
- **duration**, or the number of months home visits were received during pregnancy

Because of the study's focus on birth outcomes, the analysis in this section explores the variation in services received from the time of pregnancy until birth. Specifically, the study team examined the independent association between a particular characteristic, such as maternal age or the home visitor's years of experience, and the services received, over and above that of other measurable characteristics. This was done using multivariate, multilevel analysis. It is important to recognize that the findings from this exercise can tell us only which characteristics seem to matter for understanding the differences in levels of home visiting participation and which do not, not whether the relationships are causal.

To explore patterns, the study team identified a number of characteristics that, based on prior research and theory, could be important for understanding why some families received a higher dosage of services than others.⁷⁰ These characteristics are listed below.

Family level. At the family level, the characteristics include:

- the timing of the first home visit (weeks of gestation)
- indicators of maternal health or well-being at baseline (whether the mother's household was food insecure, whether the mother had low self-rated health, whether the mother reported smoking in the three months prior to pregnancy or at the time of study entry, and the presence of elevated depressive or anxiety symptoms)
- the sociodemographic characteristics of the mother (race/ethnicity, nativity status, age in years, highest education level, and residence with the infant's biological father)

⁶⁹For more detail on the statistical methods used in this section of the report and the analysis sample, see Appendix C. Appendix Table C.15 also presents information on the characteristics of the analysis sample for the results discussed here.

⁷⁰Some characteristics of potential interest were not examined further because there was limited variation across the sample. For example, most of the local programs and home visitors rated improving birth outcomes as a high priority, as shown in Table 3.1, and most of the programs had an MIS and used it to monitor and track operations, as described earlier in the chapter. While both of these characteristics are theoretically important, examining whether they help explain differences in dosage across families would not be useful due to their lack of variation across the families.

Home visitor level. Characteristics at this level are related to the home visitor's:

- amount of work experience (years working in home visiting)
- workload (family caseload size)
- amount and types of supervision received (frequency of supervisor guidance on prenatal health and whether the home visitor reported being directly observed by her supervisor in the prior year)
- intention of leaving her job in the next year

Local program level. Related characteristics include:

- indicators of the broader community environment (whether the community had a high family poverty rate [25 percent or higher] and the average density of primary care physicians)
- the presence of particular administrative and clinical sources of support (whether the program had staff members available to support CQI activities, access to a professional consultant in prenatal health, and a prenatal health provider who was rated as available, accessible, and an effective source of referral)
- the applicable evidence-based model (HFA or NFP)

Characteristics Associated with Variation in Service Delivery

The findings presented in this section explore how particular characteristics of families, home visitors, and local programs are related to the variation observed across families in the number of home visits received and in the duration of participation during pregnancy. More specifically, details are presented on how much the number of visits varied and the number of months of service receipt varied depending on family, home visitor, and local program characteristics.⁷¹ Box 3.1 provides further information on the statistical modeling approach used in this section and guidance on how to interpret the results presented.

⁷¹Similar analyses were conducted for two additional service delivery measures: (1) whether the family had any home visits during pregnancy (Appendix Table C.18) and (2) whether the mother received a referral for prenatal health or maternal physical health during pregnancy (Appendix Table C.19). The findings presented in this chapter on dosage (that is, the number of home visits and the months of participation) are largely consistent with the two other service delivery measures presented in Appendix C. Therefore, the results of these other analyses are not discussed here.

Box 3.1

Understanding Multivariate Models of Services Delivered During Pregnancy

Overview of approach: The findings in the “Explaining Variation in Service Delivery” section examine how the characteristics of families, home visitors, and local programs help to explain the variation observed across families in services received. Rather than focusing on examining the relationship between a single characteristic and a service delivery measure, the analyses here examine the unique relationship between a particular characteristic and home visiting services, while also taking into account a number of other characteristics. This is done using a multivariate, multilevel regression approach. For example, young maternal age is correlated with low educational attainment and a higher probability of not residing with the infant’s father. A multivariate, multilevel approach helps to isolate particular associations, such as that between maternal age and number of home visits, adjusting for differences in education levels and family structure that co-occur with maternal age, as well for differences across home visitors and local programs.

Analysis sample: The examinations in this section were conducted among a subset of program group families. In addition to the restrictions described earlier in the “Service Delivery” section (for which the sample is limited to families who had the potential to participate in home visiting services through the child’s first birthday, who did not have miscarriages, and who did not have missing data on service delivery measures), the sample is limited to families who had information across all levels (family, home visitor, and local program) on the explanatory characteristics examined and received at least one home visit. A total of 785 families were included in the analyses of dosage. Appendix C provides further information on the characteristics of the sample included in this section, compared with the larger sample of program group families.

Interpreting Figures 3.4 and 3.5: Figure 3.4 presents results from regression models that examine patterns in the number of home visits families received during pregnancy across the various family, home visitor, and local program characteristics. Figure 3.5 shows results from a similar analysis that instead looked at patterns in the duration of time (number of months) for which families received visits during pregnancy. The associations shown are adjusted for the other characteristics listed in the figures.

The dots shown in Figure 3.4 represent the difference (the increase or decrease) in the number of home visits associated with a particular characteristic over and above that of other characteristics. The dots shown in Figure 3.5 represent the difference in the duration of home visiting associated with a particular characteristic over and above that of other characteristics. For characteristics with two categories, the estimate represents the difference in the number of home visits or the duration of participation depending on whether the characteristic is present or absent. For characteristics with more than two categories, the estimate is the difference between the number of home visits or duration of participation for the categorical group compared with the reference group.

(continued)

Box 3.1 (continued)

For continuous variables (gestational age at first visit, maternal age, years of home visitor experience, caseload size, and number of primary care physicians per 10,000 persons), the difference shown is associated with an increase of one standard deviation in that characteristic.

In both figures, the horizontal lines on either side of each dot represent the 90 percent confidence interval for each association. Shorter lines indicate that the association is measured with greater certainty. When the lines are longer, they indicate greater uncertainty or noise in the estimate. An association that is statistically significant is defined as one in which the 90 percent confidence interval is either fully to the left or fully to the right of the vertical zero line.

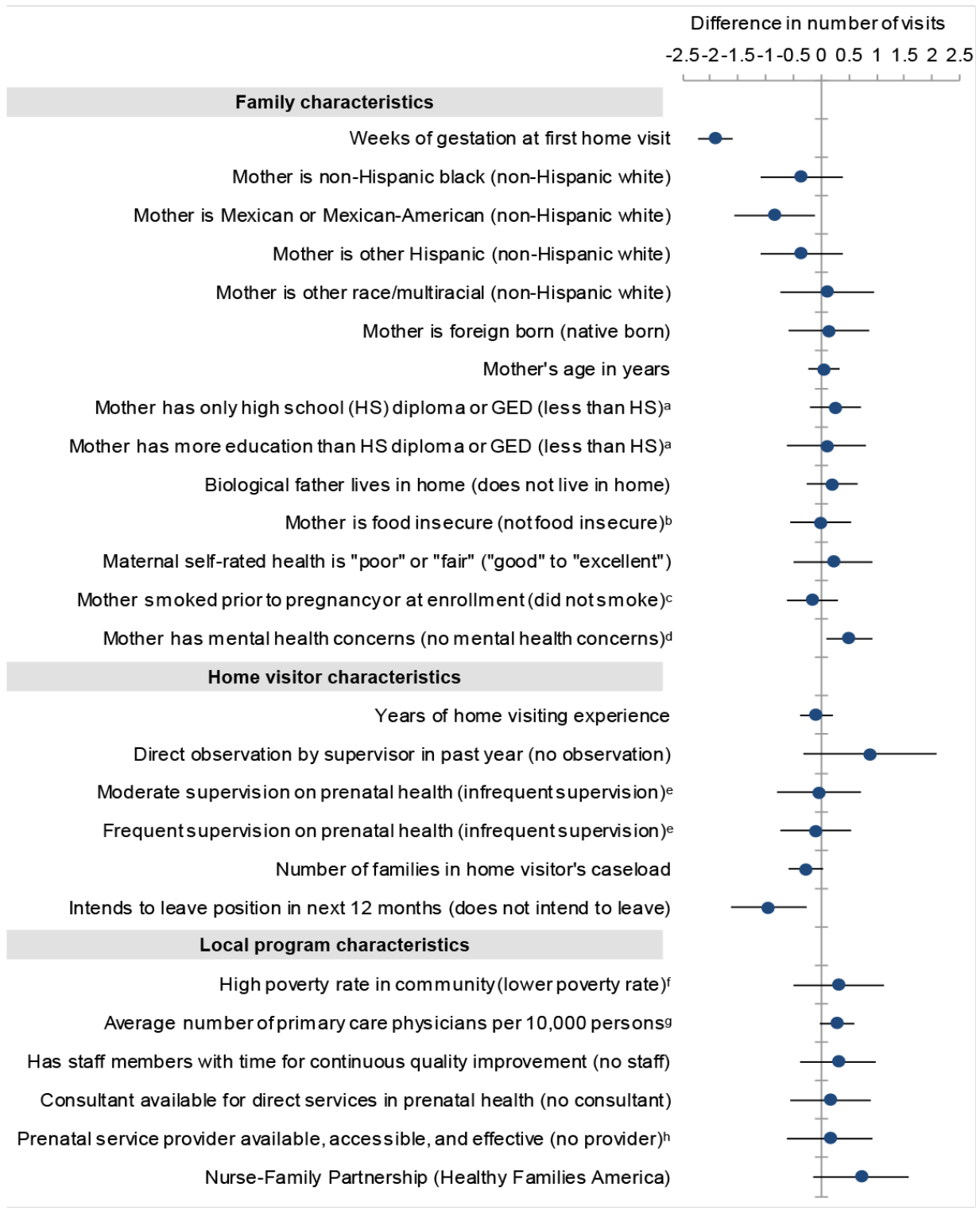
Dosage of home visiting received during pregnancy. As described earlier, among families who received at least one home visit over the study period, the average number of home visits during pregnancy was about eight. However, among families who received at least one visit during pregnancy, there was a considerable range in the number of visits received (from one to more than 30 visits) and about one-quarter of the sample received relatively few visits (four visits or fewer). Relatedly, families that participated in home visiting did so for nearly four months, on average, during pregnancy. But the range in time among families who received at least one home visit during pregnancy spanned from one week to 8.5 months.

Results from a multivariate analysis examining the variation in the number of home visits during pregnancy are presented in Figure 3.4;⁷² the full results can be found in Appendix Table C.16. Results from a similar analysis examining the variation in the number of months home visits were received during pregnancy are presented in Figure 3.5 and in greater detail in Appendix Table C.17. For most of the family characteristics examined, no statistically significant or large differences were observed in the number of home visits received and duration of participation during pregnancy. There are, however, a few patterns of statistical significance worth noting. As would be expected, mothers who received their first home visit earlier in pregnancy received more visits overall. For example, enrolling four weeks later in pregnancy is associated with two fewer visits. Also, as would be expected, mothers who received their first visit later in pregnancy had shorter durations of participation during pregnancy. Mexican or Mexican-American mothers received, on average, nearly one fewer visit than non-Hispanic white mothers,

⁷²For characteristics with two or more categories, the reference group is noted in parentheses.

Figure 3.4

Differences in the Number of Home Visits During Pregnancy Across Family, Home Visitor, and Local Program Characteristics



(continued)

Figure 3.4 Differences in the Number of Home Visits During Pregnancy (continued)

SOURCES: Calculations based on data from the MIHOPE and MIHOPE-Strong Start family baseline surveys, state vital records, the MIHOPE family service logs, management information systems, the MIHOPE home visitor baseline survey, the MIHOPE-Strong Start home visitor survey, the MIHOPE program manager baseline survey, the MIHOPE-Strong Start program manager survey, the MIHOPE and MIHOPE-Strong Start community services inventories, 2014 American Community Survey five-year estimates, 2010 U.S. Census, and 2010 American Medical Association primary care physician files.

NOTES: Results are based on multilevel, multivariate regression models. The sample is restricted to families who received at least one home visit during pregnancy and includes 785 families, 256 home visitors, and 60 local programs with information across data sources.

Coefficient estimates from this analysis are shown by the dots. The lines around each dot indicate the 90 percent confidence interval of the estimate. The reference group for characteristics with two or more categories is shown in parentheses. For these measures, the estimate represents the difference in the number of visits if the characteristic is present compared with its absence or with the reference group. For continuous variables, such as weeks of gestation at first home visit or the mother's age, the difference shown represents the increase or decrease in the number of home visits that is associated with a one standard deviation increase in the characteristic.

^aGED = General Educational Development certificate.

^bMothers were classified as having food insecurity if they indicated any experience with food not lasting or worry about food running out in the previous year. These two screening items are from the U.S. Department of Agriculture's U.S. Household Food Security Survey Module.

^cCategory includes mothers who reported any smoking in the three months prior to pregnancy or at the time of enrollment.

^dCategory includes mothers who scored at clinically elevated levels on a depressive symptoms scale or on an anxiety symptoms scale. Depressive symptoms were measured using a 10-item Center for Epidemiologic Studies Depression Scale (CES-D). A score of 8 or higher indicates clinically significant depressive symptoms. Anxiety was measured using the Generalized Anxiety Disorder 7-item scale (GAD-7). A score of 10 or higher indicates moderate or severe symptoms.

^eInfrequent supervision is defined as supervision occurring once every few months or less often. Moderate supervision is defined as supervision occurring once a month. Frequent supervision is defined as supervision occurring weekly or every other week.

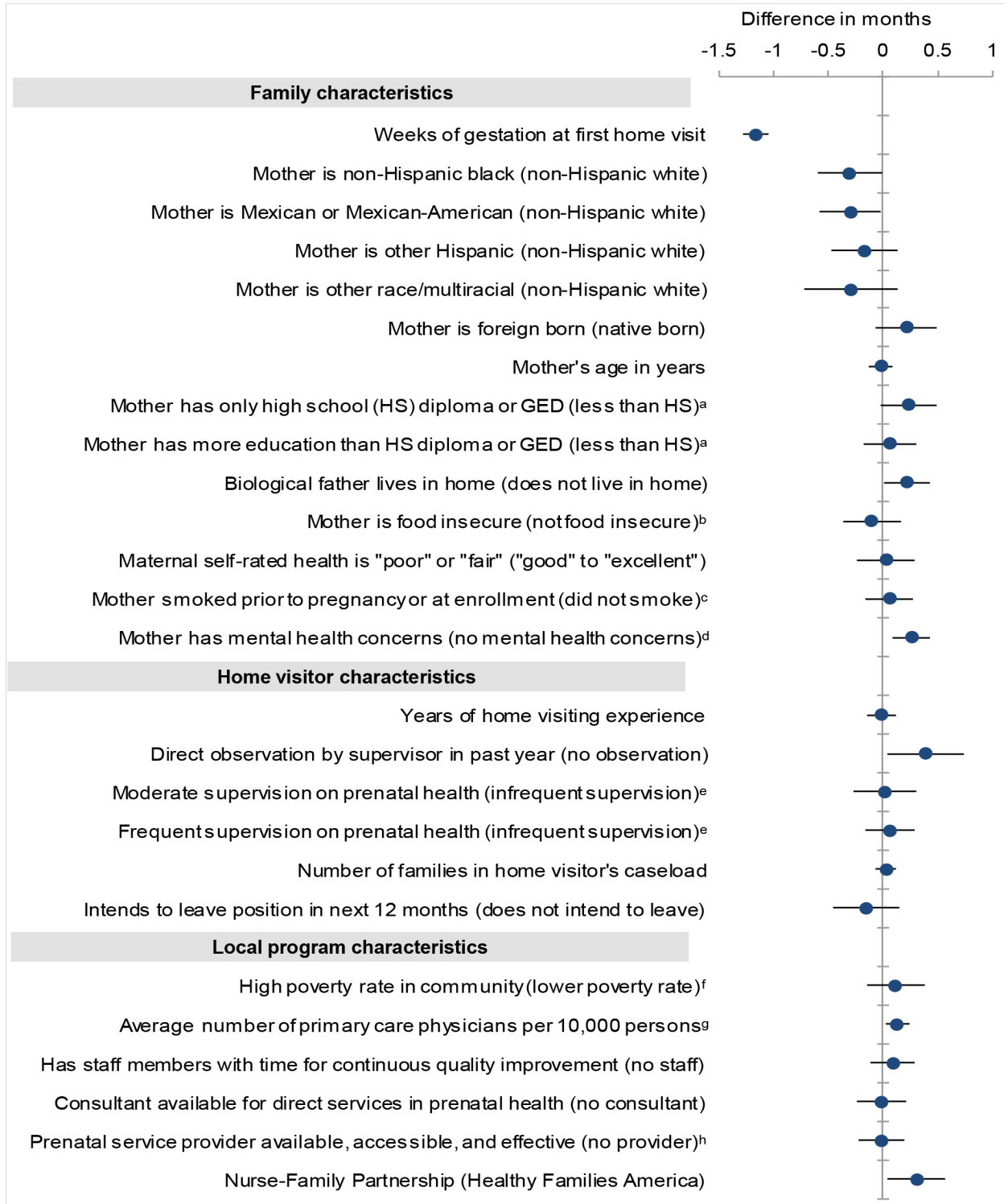
^fCategory indicates communities with an average family poverty rate of 25 percent or higher among the census tracts of sample members at the local program site.

^gNumber corresponds to the Primary Care Service Areas (PCSAs) of sample members at the local program site.

^hResponses of "don't know" and "no" were treated as non-yes responses.

Figure 3.5

Differences in Months of Home Visiting During Pregnancy Across Family, Home Visitor, and Local Program Characteristics



(continued)

Figure 3.5 Differences in Months of Home Visiting During Pregnancy (continued)

SOURCES: Calculations based on data from the MIHOPE and MIHOPE-Strong Start family baseline surveys, state vital records, the MIHOPE family service logs, management information systems, the MIHOPE home visitor baseline survey, the MIHOPE-Strong Start home visitor survey, the MIHOPE program manager baseline survey, the MIHOPE-Strong Start program manager survey, the MIHOPE and MIHOPE-Strong Start community services inventories, 2014 American Community Survey five-year estimates, 2010 U.S. Census, and 2010 American Medical Association primary care physician files.

NOTES: Results are based on multilevel, multivariate regression models. The sample is restricted to families who received at least one home visit during pregnancy and includes 785 families, 256 home visitors, and 60 local programs with information across data sources.

Coefficient estimates from this analysis are shown by the dots. The lines around each dot indicate the 90 percent confidence interval of the estimate. The reference group for characteristics with two or more categories is shown in parentheses. For these measures, the estimate represents the difference in the number of months of home visiting if the characteristic is present compared with its absence or with the reference group. For continuous variables, such as weeks of gestation at first home visit or the mother's age, the difference shown represents the increase or decrease in months of home visiting that is associated with a one standard deviation increase in the characteristic.

^aGED = General Educational Development certificate.

^bMothers were classified as having food insecurity if they indicated any experience with food not lasting or worry about food running out in the previous year. These two screening items are from the U.S. Department of Agriculture's U.S. Household Food Security Survey Module.

^cCategory includes mothers who reported any smoking in the three months prior to pregnancy or at the time of enrollment.

^dCategory includes mothers who scored at clinically elevated levels on a depressive symptoms scale or on an anxiety symptoms scale. Depressive symptoms were measured using a 10-item Center for Epidemiologic Studies Depression Scale (CES-D). A score of 8 or higher indicates clinically significant depressive symptoms. Anxiety was measured using the Generalized Anxiety Disorder 7-item scale (GAD-7). A score of 10 or higher indicates moderate or severe symptoms.

^eInfrequent supervision is defined as supervision occurring once every few months or less often. Moderate supervision is defined as supervision occurring once a month. Frequent supervision is defined as supervision occurring weekly or every other week.

^fCategory indicates communities with an average family poverty rate of 25 percent or higher among the census tracts of sample members at the local program site.

^gNumber corresponds to the Primary Care Service Areas (PCSAs) of sample members at the local program site.

^hResponses of "don't know" and "no" were treated as non-yes responses.

as shown in Figure 3.4, and they participated for slightly shorter durations than white mothers, as shown in Figure 3.5. Finally, mothers who reported symptoms of depression or anxiety at baseline received 0.5 more home visits and participated for about a week longer than mothers without such mental health risk.

Several home visitor and local program characteristics appear to be relevant for understanding patterns in dosage during pregnancy. The first is whether the home visitor intends to leave her job in the next year (reported at the time of the staff survey). Families who worked with home visitors with this intention received an average of one fewer visit than other families (Figure 3.4). A home visitor's intention to leave her job could indicate burnout or job dissatisfaction but could also indicate occupational mobility (that is, an

intention to move to a management level). Whether leaving the job is a proxy for burnout or for mobility, this finding suggests an association between a home visitor's plans to leave and a lower number of home visits.

Another relevant characteristic is whether the home visitor had been directly observed by a supervisor. Families who had a home visitor who had been directly observed by a supervisor in the prior year participated in home visiting for longer durations (0.4 months) during pregnancy than other families (Figure 3.5). Although the direction of the pattern for the number of home visits is similar (Figure 3.4), whether a home visitor had been directly observed does not have a statistically significant independent association with the number of visits that families received.

Finally, even after adjusting for the timing of the first home visit and other characteristics, families in NFP programs participated for slightly longer durations (0.3 months more) during their pregnancies than families in HFA programs (Figure 3.5). Again, though the pattern for the number of home visits goes in a similar direction on this characteristic (Figure 3.4), there the association with the program model is not statistically significant after adjusting for other family, staff, and local program characteristics.

Conclusion

Across the various aspects of implementation described in this chapter, for the most part, local programs reported that they had systems in place to guide, monitor, and support home visitors in their work. Home visitors' perceptions appear to align with these assessments, with most reporting that the implementation systems at their local programs were strong and rating their own effectiveness levels as high. At the same time, there is some room for improvement — about one-third of home visitors reported receiving infrequent guidance from their supervisors on prenatal health content, and about 13 percent said they were never directly observed by their supervisors in the year prior to the survey. In addition, although most home visitors reported workloads that they could handle, about 23 percent reported that there was too little time to do all the things that their program expected of them.

Most program group families received a lower dose of home visiting from the first visit until the child's first birthday than called for by the evidence-based models. These findings on dosage are very much in line with prior studies, including the earlier trials of HFA and NFP that examined home visiting impacts on birth outcomes. Moreover, the examination of patterns in service delivery during pregnancy suggests that women who received at least one home visit and exhibited risks for compromised birth

outcomes, such as younger age, smoking, food insecurity, and poor or fair health status, received the same levels of dosage as other women. That is, women who were more vulnerable to poor birth outcomes (at least as measured in this study) were as likely to engage in home visiting and did so to similar degrees as women who were less vulnerable.

Chapter 4

Estimated Impacts on Prenatal Health, Birth Outcomes, and Health Care Use in the First Year

With Chapter 3 having shown that the home visiting programs in the Mother and Infant Home Visiting Program Evaluation-Strong Start (MIHOPE-Strong Start) were structured to support improvements in prenatal health, birth outcomes, and infant health, and that program group families received a typical level of services, this chapter turns to the examination of whether the local programs in fact improved the prenatal health, birth outcomes, and health care use of mothers and their infants in the first year. The chapter focuses on eight prespecified outcomes that were chosen because they are likely to be affected by home visiting; because they address and have the potential to contribute to an important policy issue (for instance, improvements in the outcome might be able to reduce health care costs); and because the outcome was reliably measured.¹ In line with the Institute of Education Sciences (IES) at the U.S. Department of Education, the following eight prespecified outcomes are considered “confirmatory”:

- smoking during the third trimester of pregnancy
- low birth weight
- preterm birth
- admission to a neonatal intensive care unit (NICU)
- breastfeeding at discharge from the birth hospital
- emergency department (ED) visits among infants
- hospitalizations after birth among infants
- the number of well-child visits

This chapter also examines home visiting’s impacts on “exploratory” outcomes.² They are considered exploratory because: (1) there is little or weak evidence that home

¹Although reducing health care costs is not a stated goal of Healthy Families America or Nurse-Family Partnership, the evidence-based models have the potential to do so by improving maternal and child health and well-being and promoting the use of child preventive care.

²The exploratory outcomes include: (1) the number of cigarettes (none, 1-10, 11-20, or 21 or more) the mother smoked each day in the third trimester; (2) whether mothers who smoked prior to

visiting would make a difference in the outcome, or (2) there are questions about how well the outcome is measured in the administrative data used for the study. For these reasons, impacts on exploratory outcomes should be interpreted with caution and warrant further research.

Finally, in addition to presenting the impacts of home visiting overall, this chapter presents impacts for several subgroups of families based on risk factors and explores whether impacts vary across local home visiting programs.

Findings in Brief

- **The local Healthy Families America (HFA) and Nurse-Family Partnership (NFP) home visiting programs in MIHOPE-Strong Start did not have a discernible effect on the confirmatory outcomes.** The study found that home visiting did not result in statistically significant improvements in any of the eight confirmatory outcomes, covering the areas of prenatal health, birth outcomes, and infant health care use.
- **There are statistically significant impacts on several exploratory outcomes.** For seven exploratory outcomes, estimated effects are statistically significant. Several of these estimates suggest that program group families fared worse than control group families on rare birth outcomes. For example, the program group was more likely than the control group to have very low birth weight babies, very preterm births, and longer stays in the hospital and the NICU at birth. These outcomes are exploratory in part because they have not been found in previous

pregnancy stopped smoking by the third trimester; (3) whether the mother gained the recommended amount of gestational weight; (4) whether the mother received adequate prenatal care; (5) any ED use in pregnancy and the number of such visits; (6) any hospital observation stays during pregnancy; (7) the proportion of the prenatal period covered by Medicaid; (8) very low birth weight; (9) high birth weight; (10) birth weight (in grams); (11) early birth; (12) very preterm birth; (13) the obstetric estimate of gestation (in weeks); (14) the infant's size for gestational age (small or large); (15) the length of any stay in the NICU (in days); (16) whether the infant had a hospitalization for birth and the length of such stay (in days); (17) whether there was a Cesarean section delivery and whether it was for a nonbreach, first-time, singleton birth; (18) the length of the mother's hospitalization for delivery (in days); (19) the number of times the infant had an ED visit in the first year; (20) the number of nonbirth hospitalizations for the infant and the number of days stayed; (21) compliance with recommended well-child visits (0-50 percent, 51-75 percent, more than 75 percent); (22) any immunizations for the infant and the number received; (23) the proportion of the first year that the infant was covered by Medicaid; (24) the proportion of the first year that the mother was covered by Medicaid; (25) whether the mother had a postpartum visit; and (26) whether the mother had any ED visits in the first year and the number of such visits.

studies of HFA and NFP, but they may warrant additional research to understand whether they represent the true effects of the two evidence-based models.

- **Home visiting provided by the programs in the study does not appear to have had larger effects for any subgroups of families.** The analysis compared outcomes across risk factors including smoking, gestational age at study entry, maternal age, and race and ethnicity. In general, the estimated impacts of the study's eight confirmatory outcomes do not differ across subgroups of families, suggesting that home visiting did not have greater effects for higher-risk families or for lower-risk families.
- **The effects of home visiting do not vary across local programs in the study.** The lack of impacts for the full sample appears to hold across local programs. The analyses did not find that impacts differed between the evidence-based models or according to how local programs were implemented.

Prior Evidence from Healthy Families America and Nurse-Family Partnership Studies

In the last four decades, several studies of HFA and NFP have examined the effects of home visiting on birth and related outcomes. The following discussion focuses mostly on randomized controlled trials (RCTs) rated as moderate or high quality by the Home Visiting Evidence of Effectiveness (HomVEE) review commissioned by the U.S. Department of Health and Human Services (HHS). The discussion is limited to the studies that evaluated outcomes that are similar to the confirmatory outcomes examined in MIHOPE-Strong Start. These studies include HFA evaluations conducted in Alaska, Arizona, Hawaii, New York, Oregon, and San Diego, as well as NFP studies in Denver; Elmira, New York; Memphis; and Orange County, California. Summaries of these earlier evaluations are shown in Table 4.1. The prior evidence presented in Table 4.1 focuses on full sample results rather than findings for specific subgroups and limits the follow-up period to the first two years after birth.

Table 4.1
Prior Evidence on MIHOPE-Strong Start Confirmatory Outcomes

MIHOPE-Strong Start Outcome	Prior Studies		
	Sample Size	Estimate Statistically Significant and Favorable	Outcome
<u>Maternal health during pregnancy</u>			
Any smoking during third trimester ^a (%)			
NFP Denver – Olds et al. (2002)	120	Yes	Cotinine reduction at 36th week
NFP Elmira – Olds, Henderson, Tatelbaum, and Chamberlin (1986)	141	Yes	Change in number of cigarettes smoked at 32nd week
NFP Memphis ^b – Kitzman et al. (1997); Miller (2015)	NA	No	Change in number of cigarettes smoked
<u>Birth outcomes</u>			
Low birth weight (< 2,500 grams) (%)			
HFA NY ^c – Lee et al. (2009)	501	Yes	Low birth weight (< 2,500 grams)
NFP Denver ^b – Olds et al. (2002); Miller (2015)	443	No	Low birth weight (< 2,500 grams)
NFP Elmira – Olds, Henderson, Tatelbaum, and Chamberlin (1986)	308	No	Low birth weight (\leq 2,500 grams)
NFP Memphis – Kitzman et al. (1997)	1,082	No	Low birth weight (< 2,500 grams)
NFP Orange Co. ^d – Nguyen, Carson, Parris, and Place (2003); Miller (2015)	156	No	Low birth weight (< 2,500 grams)
Premature birth (< 37 weeks) (%)			
HFA NY ^c – Lee et al. (2009)	501	No	Premature birth (< 37 weeks)
NFP Denver ^b – Olds et al. (2002); Miller (2015)	459	No	Premature birth (< 37 weeks)
NFP Elmira – Olds, Henderson, Tatelbaum, and Chamberlin (1986)	308	No	Premature birth (< 37 weeks)
NFP Memphis – Kitzman et al. (1997)	1,082	No	Premature birth (< 37 weeks)
NFP Orange Co. ^d – Nguyen, Carson, Parris, and Place (2003); Miller (2015)	154	Yes	Premature birth (< 37 weeks)
<u>Breastfeeding</u>			
Infant ever breastfed (%)			
HFA Arizona – LeCroy and Davis (2017)	199	Yes	Ever breastfed
HFA NY – Mitchell-Herzfeld et al. (2005)	1,061	No	Ever breastfed
HFA Oregon – Green et al. (2014)	803	No	Ever breastfed
NFP Elmira ^b – Olds, Henderson, Tatelbaum, and Chamberlin (1986); Miller (2015)	189	No	Attempted breastfeeding
NFP Memphis – Kitzman et al. (1997)	671	Yes	Attempted breastfeeding

(continued)

Table 4.1 Prior Evidence on Confirmatory Outcomes (continued)

	Prior Studies		
	Sample Size	Estimate Statistically Significant and Favorable	Outcome
MIHOPE-Strong Start Outcome			
<u>Infant health care use at birth</u>			
Admitted to NICU (%)			
HFA NY ^e – Mitchell-Herzfeld et al. (2005)	519	No	Use of NICU following birth
<u>Infant health care use in the first year</u>			
Any emergency department (ED) visits (%)			
HFA Alaska – Caldera et al. (2007)	268	No	No ED visits in first 2 years
HFA Hawaii – Duggan et al. (1999)	564	No	Any ED visits in first year
HFA Hawaii – Duggan et al. (1999)	534	No	Any ED visits in first 2 years
Any nonbirth hospitalizations (%)			
HFA Alaska – Caldera et al. (2007)	268	No	No hospitalizations in first 2 years
HFA Hawaii – Duggan et al. (1999)	564	No	Any hospitalizations in first year
HFA Hawaii – Duggan et al. (1999)	534	No	Any hospitalizations in first 2 years
Average number of well-child office visits			
HFA Arizona – LeCroy and Davis (2017)	199	No	Number of well visits in first 6 months
HFA NY – Mitchell-Herzfeld et al. (2005)	1,061	No	Number of well visits in first year
HFA Oregon – Green, Tarte, Sanders, and Waller (2016)	2,238	No	Number of well visits in first 2 years
HFA San Diego – Landsverk et al. (2002)	435	No	Number of well visits in first year
HFA San Diego – Landsverk et al. (2002)	403	Yes	Number of well visits in second year
NFP Memphis – Kitzman et al. (1997)	671	No	Number of well visits in first 2 years

SOURCE: MDRC summary of prior research.

NOTES: NA = Not available, NICU = neonatal intensive care unit.

This table includes prior studies of Healthy Families America (HFA) or Nurse-Family Partnership (NFP) that were rated high or moderate quality in the Home Visiting Evidence of Effectiveness (HomVEE) review and that analyzed impacts on outcomes that are confirmatory in MIHOPE-Strong Start. An HFA study from Arizona is not in HomVEE but is included here. Some of the studies designated as moderate or high quality in HomVEE have findings that were published in reports or articles that were not included in HomVEE; those results are included here. This table includes only evidence in the first two years of follow-up.

^aOutcome was measured among women who smoked at study intake.

^bThe authors of the study that first reported results did not include findings for this measure. A meta-analysis by Miller (2015) analyzed NFP's impacts across different studies and presented calculations for this measure in that article.

^cOutcome was measured among women randomized at a gestational age of 30 weeks or less.

^dEstimate of statistical significance is based on calculations presented in Miller (2015); Nguyen, Carson, Parris, and Place (2003) did not include information on statistical significance.

^eOutcome was measured among women randomized at least two months before the child's birth.

As described in Chapter 1, three NFP studies, conducted in Denver, Elmira, and Memphis, examined tobacco use during pregnancy; two of these studies found reductions in smoking by late pregnancy among women who smoked at study intake.³

Turning to birth outcomes, only the HFA New York study found a statistically significant reduction in the prevalence of low birth weight, but the study did not find corresponding reductions in preterm births.⁴ The only NFP study to have found improvements in birth outcomes for the full sample is the NFP Orange County trial, which found statistically significant reductions in preterm birth, but not in low birth weight prevalence.⁵ Additionally, although the NFP Elmira trial found statistically significant reductions in preterm births for smokers and very young mothers, the study did not find significant effects on low birth weight and preterm birth for the full study sample.⁶ This latter finding is consistent with the full sample findings for two other studies that examined low birth weight and preterm birth (NFP Memphis and NFP Denver).⁷

There is evidence from the HFA Arizona evaluation and NFP Memphis study that home visiting increased the likelihood that breastfeeding was attempted or initiated.⁸ However, in three other studies that looked at breastfeeding initiation, HFA New York, HFA Oregon, and NFP Elmira, statistically significant increases were not found.⁹ For mothers in the HFA New York study with an older child, home visiting was found to have increased breastfeeding initiation rates.¹⁰

In terms of infant health care use, only one prior study, HFA New York, examined NICU admission following birth, and it did not find statistically significant differences between research groups.¹¹ Infant health care use in the first two years has been examined

³Kitzman et al. (1997); Miller (2015); Olds et al. (2002); Olds, Henderson, Tatelbaum, and Chamberlin (1986). In the NFP Memphis trial (Kitzman et al., 1997), the authors of the original study did not report estimated effects on smoking, but a subsequent meta-analysis presented results from this trial showing no statistically significant impact on tobacco use during pregnancy (Miller, 2015).

⁴Lee et al. (2009).

⁵Nguyen, Carson, Parris, and Place (2003); calculations of statistical significance were not reported in the original trial but were calculated in Miller (2015).

⁶Olds, Henderson, Tatelbaum, and Chamberlin (1986).

⁷Kitzman et al. (1997); Olds et al. (2002). Effects on birth outcomes were not reported in the original NFP Denver trial (Olds et al., 2002), but these estimates were presented in a later analysis (Miller, 2015).

⁸LeCroy and Davis (2017); Kitzman et al. (1997).

⁹Mitchell-Herzfeld et al. (2005); Green et al. (2014); Olds, Henderson, Tatelbaum, and Chamberlin (1986); Miller (2015).

¹⁰Mitchell-Herzfeld et al. (2005).

¹¹Mitchell-Herzfeld et al. (2005).

more often: Two studies looked at any ED use; two studies looked at any nonbirth hospitalizations; and five studies examined the number of well-child visits received.¹² No reduction in ED use or hospitalizations was found, but HFA San Diego documented an increase in well-child visits in the child's second year of life.¹³

In addition to these RCTs, a quasi-experimental national study of NFP compared NFP clients' rates of low birth weight and preterm births with the rates among similar families by using a propensity score matching design.¹⁴ Similar to the RCTs, this study did not find that NFP home visiting programs reduced the prevalence of low birth weight. It did, however, find statistically significant reductions in preterm births.

Thus, the findings are mixed: Some prior high- and moderate-quality studies have shown favorable findings in five of the eight confirmatory outcomes examined in MIHOPE-Strong Start, but, more often, studies that have looked at these outcomes have not found statistically significant impacts. To some extent, favorable impacts have been concentrated among subgroups of families rather than the full study samples, although these subgroup findings have not been replicated across studies.

MIHOPE-Strong Start Sample and Data Sources

The MIHOPE-Strong Start analysis includes 2,900 pregnant women from 66 local HFA and NFP programs in 17 states. Four families were excluded from the impact analysis because they came from one of three local programs in which all families were assigned to the same research group.¹⁵ Thus, the final analysis sample includes 2,896 mothers (1,569 in the program group and 1,327 in the control group). As described in the previous chapter, most of the 1,569 mothers in the program group families received at least one home visit (86 percent), but 14 percent did not receive any visits. As is standard practice in studies that use random assignment, program group families were included in the analysis even if they did not receive any home visiting services.¹⁶ This is done to

¹²Table 4.1 shows the same study twice if an outcome was measured at two time periods during the first two years. For example, the HFA Hawaii study examined ED visits in (1) the first year and (2) the first two years combined. For well-child visits, the HFA San Diego study measured the number of such visits in (1) the first year and (2) the second year.

¹³Landsverk et al. (2002).

¹⁴Thorland and Currie (2017).

¹⁵For these sites, impacts — the differences in outcomes between randomly assigned program and control group members — could not be estimated because all sample members were randomly assigned to either the program or control group.

¹⁶See, for example, Chapter 2 of Orr (1999).

maintain the comparability between program and control groups that was generated by random assignment.¹⁷

Since the study enrolled women during pregnancy, it includes some women who had miscarriages, stillbirths, or fetal deaths. The study team learned of or suspected that there were 155 families for whom one of these outcomes occurred and birth records were consequently not available.¹⁸ In addition, birth records indicated that 49 pairs of twins were born to women in the sample. Thus, the maximum sample size for infant outcomes is 2,790 (after excluding 155 cases of nonlive births and including 49 twins).

Further details on the sample size and data availability are provided in Appendix A (see the “Analysis Samples” section).

Data Sources and Availability

To understand home visiting’s effects on maternal and infant health and health care use, the impact analyses used several data sources:

- Information from the baseline surveys conducted with families, vital records data, and Medicaid enrollment data (as described in Chapter 1) was used to define and improve the precision of impact estimates.
- Information from staff surveys and information collected on home visiting services received by program group families, as described in Chapter 1 and Chapter 3, were used to explore how impacts vary with program implementation.
- State vital records and Medicaid data were used to measure family outcomes. Administrative data agencies from each state in the study provided data that could be linked with family baseline surveys.

The two administrative data sources are described briefly below.

¹⁷Because program group families who did not receive home visiting may differ in unobserved ways from program group families who did receive home visiting, program group families who received home visiting may differ from control group families in ways that are unrelated to their access to evidence-based home visiting. Differences in outcomes between those two groups may therefore not reflect the effects of being given access to evidence-based home visiting.

¹⁸The difference between research groups for the rate of miscarriages, stillbirths, and fetal deaths combined is not statistically significant. Maternal outcomes, such as gestational weight gain and adequate prenatal care, were analyzed in fetal death cases, as the information was still available from the fetal death record.

Vital records. Birth records were received for 95 percent of cases in which a live birth was likely to have occurred (2,650 out of 2,790 infants).¹⁹ The other 5 percent could not be matched to the study sample, which could be because the study team did not have the same identifying information as the state or because the pregnancy ended in a miscarriage, stillbirth, or fetal death but the study team did not have sufficient information to make that assumption.²⁰

Medicaid data. For outcomes based on Medicaid data, all 2,896 mothers and the 2,790 infants who were not known or suspected of being a miscarriage, stillbirth, or fetal death were included in the analysis. For 88 percent of families (2,548 mothers and 2,470 infants), Medicaid data could be collected through the first year after birth. Because of when states sent data to the study team, only a partial year of postbirth data could be collected for 9 percent of families (266 mothers and 248 infants) and no Medicaid data were available after birth for 3 percent of families (82 mothers and 72 infants).

Most sample members — 90 percent of mothers and 79 percent of infants — were enrolled in Medicaid at least some of the time.²¹ More than half of all mothers and infants were enrolled in Medicaid for the entire year after birth, although only 43 percent of mothers were enrolled for the full prenatal period.²² In the data collected for the study, 10 percent of mothers (303 out of 2,896) and 21 percent of babies (587 out of 2,790) were not matched to Medicaid data in the 12 months after birth. These sample members might never have enrolled in Medicaid, might have been enrolled but not matched to the sample, might have been uninsured, or might have had private health insurance.²³ The current analysis includes all mothers and infants, regardless of whether they were

¹⁹It is possible that the 140 cases for which a birth record was not received include some pregnancies that did not end in a live birth.

²⁰Match rates to vital records were similar for the program and control groups.

²¹For all mothers and infants in MIHOPE-Strong Start, only Medicaid records were collected (as opposed to gathering additional data from private health plans or providers or from individuals' reports of health care use). Therefore, although 90 percent of mothers and 79 percent of infants had Medicaid coverage for at least a portion of the evaluation period, they also may have been uninsured for a period of time or they may have had private health insurance. It is also possible that these mothers and infants were insured by Medicaid in a state from which the study team did not collect Medicaid data because it did not have a local HFA or NFP program participating in MIHOPE-Strong Start.

²²Multiple imputation was used to estimate impacts on the three confirmatory outcomes related to health care use for infants enrolled in Medicaid for only a portion of the first year after birth (see Appendix Table E.2). These results are generally consistent with those shown in the main impact table (Table 4.4).

²³When Medicaid data were not received for sample members, outcome levels for these members were set to zero, which probably results in underestimates of how much Medicaid-paid health care was used. Data were received for a similar percentage of families in the program and control groups.

matched to Medicaid data, in estimating Medicaid use. As a result, the outcomes should be considered Medicaid-paid health care use.

Statistical Considerations

As described in Chapter 1, the study randomly assigned families to either a program group or a control group to provide rigorous estimates of the effects of access to home visiting on health outcomes. Control group members were given information on other community services, and the study team sought to recruit local programs that were located in an environment without other comparable evidence-based home visiting services or services funded by the Strong Start for Mothers and Newborns Initiative. Thus, comparing the outcomes of the program and control groups provides an estimate of the effects of having access to evidence-based home visiting programs compared with being given information on other community services.

With the random assignment design, the impacts of home visiting could be assessed by comparing the average outcomes for the program and control groups. Results in the body of the report are based on linear regressions, even for binary outcomes. To improve the statistical precision of estimated effects, results were adjusted for baseline characteristics and clustered by family to account for twins.²⁴ Additionally, several statistical sensitivity checks were conducted, all of which found similar results to those presented in this chapter.²⁵

To assess whether home visiting programs made a difference over and above what a study might find by chance, tests of statistical significance were used. Briefly,

²⁴Covariates include indicators for the following characteristics of the mother: self-reported health status (excellent, very good, good, fair, or poor); race and ethnicity (non-Hispanic white, non-Hispanic black, Mexican or Mexican-American, other Hispanic, or other race or multiracial); level of education (less than a high school diploma or GED certificate, high school diploma or GED certificate, some college, or bachelor's degree or higher); prepregnancy body mass index (underweight, normal weight to overweight, or obese); enrollment in Medicaid; enrollment in Medicaid managed care; showing depressive symptoms; under age 21; born outside of the United States; pregnant with first child; singleton or multiple birth; smoking in the three months prior to pregnancy; program site; and trimester of first prenatal care visit interacted with pregnancy trimester of study enrollment. For infant outcomes, the sex of the child is included as a covariate in addition to the characteristics listed for mothers. An alternative regression model, wherein families were clustered by site, yielded consistent results (not shown).

²⁵The sensitivity checks include the following: not adjusting for family baseline characteristics (Appendix Table E.1); multiple imputations for infant outcomes derived from Medicaid data, where the infant was enrolled for only part of the first year after birth (Appendix Table E.2); excluding families with extremely high or extremely low values on key Medicaid outcomes to reduce the effect of outliers (Appendix Table E.3); and assuming a nonlinear relationship ("S-curve") between binary dependent variables and independent variables (Appendix Table E.4).

statistically significant impacts are ones that are large enough that they are unlikely to have resulted from a program with no true effect. In this report, the threshold for statistical significance is having less than a 10 percent likelihood that a difference of the observed size or greater in either direction (positive or negative) would be found when there was no real impact. Box 4.1 explains how impact estimates are measured and presented in the tables of this report.

As noted earlier, the analysis focuses on eight prespecified confirmatory outcomes. These outcomes were selected based on three criteria: (1) whether home visiting is considered likely to show effects on the outcome, based on high- and moderate-quality studies of HFA and NFP, as designated by HomVEE; (2) whether the outcome addresses an important issue related to home visiting policy; and (3) whether the outcome could be measured reliably in the available data.

Because 14 percent of program group families received no home visits and only about half of families who had a visit were still participating by the child's first birthday, it is helpful to understand the relationship between the level of home visiting services delivered and the effects of home visiting. To partially investigate this question, the analysis presented at the end of this chapter examines how impacts vary across local programs that differed in how many home visits their families received.²⁶ This analysis also investigates whether impacts vary across the two evidence-based models or by how local programs were implemented.

Impacts on Maternal Health During Pregnancy

Table 4.2 shows the estimated effects of the local evidence-based home visiting programs on maternal health behaviors and health care use during pregnancy. In this domain, the estimated effect on the sole confirmatory outcome of smoking in the last trimester of pregnancy is close to zero and not statistically significant.²⁷ There are also no statistically significant impacts on the exploratory outcomes, including: (1) the number of cigarettes smoked each day in the third trimester; (2) smoking cessation by the third trimester; (3) gaining of recommended gestational weight; (4) receipt of adequate prenatal care; (5) any ED use in pregnancy and the number of such visits; (6) any hospital

²⁶As noted in the text, this analysis is based on variation in service receipt and impacts across local programs. It is also possible to compare outcomes for families who received different amounts of home visiting, but this analysis was not conducted for methodological reasons that are discussed later in the chapter.

²⁷This measure was also assessed with a logistic regression model and produced a similar result (see Appendix Table E.4).

Box 4.1

How to Read the Tables That Show Estimated Impacts in the Report

The effects, or “impacts,” of evidence-based home visiting are estimated in MIHOPE-Strong Start by comparing outcomes for the program and control groups, adjusted for the background characteristics of the sample members, including local program affiliation. The following excerpt from Table 4.4 uses information on whether the mother had a Medicaid-paid emergency department (ED) visit to illustrate the information that is included in the report’s tables about the estimated effects.

- The first two columns (“Program Group” and “Control Group”) show the average outcomes for the two groups. In this case, the columns show that 38.8 percent of program group mothers had an ED visit, compared with 40.5 percent of control group mothers.

Effects on Breastfeeding Initiation and Medicaid-Paid Health Care Use in the First Year After Birth

Outcome	Program Group	Control Group	Difference (Impact)	P-Value ^a	90% Confidence Interval
Mother had an emergency department visit (%)	38.8	40.5	-1.7	0.311	(-4.5, 1.1)
Sample size (total = 2,896)	1,569	1,327			

- The next column (“Difference”) shows the estimated effect, or impact, of evidence-based home visiting. Since impacts are estimated as the difference in outcomes between the program and control groups, the estimated effect is -1.7 percentage points (38.8 percent in the program group *minus* 40.5 percent in the control group).
- The p-value shown in the fourth column indicates the likelihood of estimating an impact as big as the one shown if the intervention had no effect on this outcome. In this report, estimates are considered statistically significant if the p-value is 0.100 or lower. In this example, there is a 31 percent chance that a program with no effect would have generated a difference between research groups of -1.7 percentage points or larger.
- The “90% Confidence Interval” column provides information on the statistical precision of the estimated impacts. Specifically, there is a 90 percent chance that the estimated impact from any given study would fall within the 90 percent confidence interval. A narrower confidence interval suggests a more precise estimate than a wider confidence interval. Confidence intervals that contain zero within them, such as the span of -4.5 percentage points to 1.1 percentage points in this example, indicate that the impact estimate is not statistically significantly different from zero at the 10 percent level.

observation stays during pregnancy; and (7) the proportion of the prenatal period covered by Medicaid. Context for interpreting the lack of program effects on these outcomes is provided below.

Health Behaviors During Pregnancy

As described in Chapter 1, one way in which home visiting could have improved birth outcomes is by helping mothers stop smoking. As documented in Chapter 2, smoking rates among mothers at the time of study entry were already low, and Table 4.2 shows that only about 10 percent of the control group smoked in the third trimester.²⁸ In the two earlier NFP trials where positive impacts were found on smoking reductions, sample members were much more likely to smoke at study entry than sample members in this study. About 40 percent of the sample in the Elmira study were smokers and 23 percent of the Denver sample smoked.²⁹ Smoking rates in MIHOPE-Strong Start were also lower than among low-income pregnant women nationally.³⁰ These facts suggest that the opportunity for home visiting to make a substantial difference through this pathway was limited. Nonetheless, it is also important to note that only about 38 percent of smokers in the study had stopped smoking by the third trimester,³¹ suggesting that there is still a potential for home visiting to improve this behavior.

Among health-related behaviors, home visiting could have also improved birth outcomes by helping mothers gain the recommended amount of weight. The consequences of inappropriate weight gain differ depending on a mother's prepregnancy body mass index (BMI) and whether she gains less or more than the recommended amount of weight in relation to her BMI (for example, underweight mothers who gain less than the recommended amount of weight are at risk for giving birth to low-birth-weight infants,

²⁸The rates of smoking reported in Table 4.2 are similar to national estimates of smoking during pregnancy (Curtin and Mathews, 2016; Tong et al., 2013).

²⁹Olds, Henderson, Tatelbaum, and Chamberlin (1986); Olds et al. (2002). Note that smoking at baseline is measured somewhat differently across these studies. The NFP Denver trial defined smokers using cotinine levels (Olds et al., 2002). The NFP Elmira trial (Olds, Henderson, Tatelbaum, and Chamberlin, 1986) defined smokers as smoking at least five cigarettes a day at study intake (about 40 percent of the sample) and used maternal reports. Also note that Kitzman et al. (1997), in reporting results from the NFP Memphis trial, cited a smoking rate of 55 percent in the NFP Elmira sample, defining smokers as women who self-reported smoking at least one cigarette per day.

³⁰Based on 2014 birth certificate data, 14 percent of mothers who had Medicaid payment for delivery smoked at any time during pregnancy (Curtin and Mathews, 2016).

³¹This group includes the women who smoked in the three months before pregnancy or during the first two trimesters (351 women).

Table 4.2
Effects on Maternal Health During Pregnancy

Outcome	Program Group	Control Group	Difference (Impact)	P-Value ^a	90% Confidence Interval
<u>Confirmatory (%)</u>					
Any smoking during third trimester	9.9	9.6	0.3	0.685	(-1.0, 1.7)
<u>Exploratory</u>					
<u>Health behaviors (%)</u>					
Number of cigarettes smoked per day during third trimester					
None	90.1	90.4	-0.3	0.685	(-1.7, 1.0)
Low (1-10)	8.5	7.8	0.7	0.419	(-0.7, 2.1)
Medium (11-20)	1.3	1.6	-0.2	0.645	(-1.1, 0.6)
High (21 or more)	0.1	0.3	-0.1	0.534	(-0.5, 0.2)
Smoking cessation by third trimester among smokers ^b	34.8	37.8	-3.0	0.608	(-12.5, 6.6)
Gained recommended weight during pregnancy ^c	27.6	27.2	0.4	0.847	(-2.8, 3.5)
<u>Health care use during pregnancy</u>					
Adequate prenatal care ^d (%)	81.6	82.1	-0.4	0.762	(-2.9, 2.0)
Any emergency department (ED) visits ^e (%)	50.1	50.5	-0.4	0.795	(-3.2, 2.3)
Average number of ED visits ^e	1.42	1.46	-0.04	0.657	(-0.17, 0.10)
Any hospital observation stays ^e (%)	16.7	16.5	0.1	0.908	(-1.9, 2.2)
<u>Health coverage during pregnancy</u>					
Average proportion of prenatal period enrolled in Medicaid	75.7	75.3	0.4	0.591	(-0.9, 1.7)
Ever enrolled in Medicaid during prenatal period (%)	89.7	89.1	0.6	0.520	(-1.0, 2.2)
Fully enrolled (%)	45.4	44.4	1.0	0.519	(-1.5, 3.4)
Partially enrolled (%)	44.3	44.7	-0.3	0.841	(-3.1, 2.5)
Sample size (total = 2,896)	1,569	1,327			

(continued)

Table 4.2 Effects on Maternal Health During Pregnancy (continued)

SOURCES: Calculations based on state vital records and Medicaid enrollment and claims data.

NOTES: Estimates were regression-adjusted using generalized least squares, controlling for pre-random assignment characteristics of sample members and weighted to adjust for differing random assignment ratios used in MIHOPE and MIHOPE-Strong Start. Pre-random assignment characteristics were mean centered and interacted with the treatment variable to reduce the potential for bias since the sample was not randomized in equal numbers to the program and control groups.

See Appendix D for descriptions of the outcome measures used.

^aThe p-value indicates the likelihood of estimating an impact of this magnitude or larger if the intervention had zero effect.

^bThis measure includes only the 351 women who smoked in the three months prior to pregnancy or in the first two trimesters (15.6 percent of the 2,250 sample members for whom this information is available).

^cAppropriate gestational weight gain is based on recommendations from the Institute of Medicine, which vary by prepregnancy Body Mass Index (BMI).

^dAdequacy of prenatal care is measured according to a modified Kotelchuck Adequacy of Prenatal Care Utilization (APNCU) index: the APNCU-2 M. It accounts for initiation of prenatal care, the ratio of observed to expected number of visits (based on gestational age), the difference between the number of observed and expected visits, and a threshold of receipt of at least nine visits. Possible categories include Adequate Plus, Adequate, and Not Adequate. In this table, Adequate includes both Adequate and Adequate Plus.

^eThis measure only accounts for health care use paid for by Medicaid.

but overweight women who gain less than recommended amount of weight do not appear to face similar risks).³² For those who did not gain the recommended amount of weight, the majority of women gained too much (about two-thirds of women gained too much weight and one-third gained too little).³³ Although this is consistent with the national average,³⁴ it suggests that this is an area where home visiting has the potential to improve prenatal well-being in the future.

Health Care Use and Health Coverage During Pregnancy

Although the home visiting programs did not improve the adequacy of prenatal care received, this was an area in which there was little room for improvement. Most mothers in the control group (82 percent) received adequate care, as measured by a modified Kotelchuck Adequacy of Prenatal Care Utilization (APNCU) index: APNCU-2 M. One possible explanation is the high rate of Medicaid receipt in the sample: About 90 percent of both the program group and control group were enrolled in Medicaid at some

³²Galtier-Dereure, Boegner, and Bringer (2000); Ehrenberg, Dierker, Milluzzi, and Mercer (2003).

³³For women who gained less than the recommended amount of weight according to their prepregnancy BMI category, the median was gaining seven pounds too few. Women who were underweight prior to pregnancy, however, tended to only gain five pounds less than recommended. For women who gained more than the recommended amount, the median was 12 pounds too many.

³⁴Centers for Disease Control and Prevention (2017b).

point during the woman’s pregnancy. Nevertheless, the rate of adequate prenatal care in MIHOPE-Strong Start is higher than that found in other studies. For example, according to the 2011 Pregnancy Risk Assessment Monitoring System (PRAMS) data, 59 percent of women enrolled in Medicaid at any time during pregnancy had adequate prenatal care.³⁵ It is possible that the expansion of Medicaid under the Affordable Care Act could have increased the receipt of health care services for this population. It is also possible that the group of mothers being referred to the home visiting programs was more likely to receive prenatal care. Nonetheless, as described in Chapter 1, the lack of impacts on prenatal care receipt is consistent with prior evaluations of NFP and HFA New York, which were conducted before enactment of the Affordable Care Act.³⁶

Impacts on Birth Outcomes and Related Care

Table 4.3 shows the estimated effects of home visiting on birth outcomes and health care use at the time of birth. The estimated effects on the three confirmatory outcomes — low birth weight, preterm birth, and admission to the NICU — are not statistically significant.³⁷ This is consistent with the lack of impacts on the outcomes related to the mother during pregnancy.

In contrast to the confirmatory birth outcomes, 5 out of the 14 exploratory outcomes measured at delivery have statistically significant estimated effects. These results should be interpreted cautiously, however. First, these outcomes were considered exploratory because there was little or no evidence about them from prior studies of home visiting. Second, several of these differences are quite small, and while statistically significant, they may not be meaningful in a real-world context. For example, program group babies were born, on average, one day earlier than control group babies. Third, the exploratory outcomes that are statistically significant indicate slightly worse outcomes for program group families than for control group families, and it is difficult to think of reasons why home visiting would have resulted in worse outcomes. Nevertheless, it is impossible to rule out the possibility of unintended impacts, which is an area that may warrant additional research, particularly given the exploratory nature of the outcomes.

The remainder of this section discusses these outcomes, beginning with the confirmatory outcomes.

³⁵Pregnancy Risk Assessment Monitoring System (PRAMS) Data Portal (2018).

³⁶Olds, Henderson, Tatelbaum, and Chamberlin (1986); Kitzman et al. (1997); Lee et al. (2009).

³⁷For all birth outcomes, a sensitivity check was conducted to see whether excluding twins from the analysis would affect the results, but the findings did not change. For the program group, 1.8 percent of mothers gave birth to twins and, for the control group, 1.6 percent had twins (not shown).

Table 4.3
Effects on Birth Outcomes and Related Care

Outcome	Program Group	Control Group	Difference (Impact)	P-Value ^a	90% Confidence Interval
<u>Confirmatory (%)</u>					
Low birth weight (< 2,500 grams)	11.7	11.6	0.1	0.962	(-1.9, 2.0)
Preterm birth (< 37 weeks)	10.6	9.4	1.1	0.323	(-0.8, 3.1)
Infant admitted to neonatal intensive care unit (NICU) ^b	10.1	9.2	1.0	0.402	(-0.9, 2.8)
<u>Exploratory</u>					
<u>Birth outcomes</u>					
Very low birth weight (< 1,500 grams) (%)	2.7	1.6	1.0	0.071	(0.1, 2.0)
High birth weight (> 4,000 grams) (%)	5.0	5.9	-0.9	0.329	(-2.3, 0.6)
Average birth weight (grams)	3,141	3,163	-22	0.334	(-60, 16)
Early birth (< 39 weeks) (%)	36.2	34.0	2.3	0.220	(-0.8, 5.3)
Very preterm birth (< 32 weeks) (%)	2.6	1.6	1.1	0.065	(0.1, 2.0)
Average obstetric estimate of gestation (weeks)	38.4	38.6	-0.2	0.042	(-0.3, 0.0)
Small for gestational age ^c (%)	12.4	13.1	-0.7	0.621	(-2.8, 1.5)
Large for gestational age ^c (%)	7.2	7.9	-0.7	0.534	(-2.4, 1.1)
<u>Infant's health care use at birth</u>					
Average length of NICU admission ^b (days)	1.86	1.12	0.74	0.009	(0.28, 1.21)
Any hospitalizations for infant birth stay ^b (%)	76.2	75.2	1.0	0.492	(-1.4, 3.4)
Average length of birth hospitalization ^b (days)	4.18	3.59	0.59	0.053	(0.09, 1.09)

(continued)

Table 4.3 Effects on Birth Outcomes and Related Care (continued)

Outcome	Program Group	Control Group	Difference (Impact)	P-Value ^a	90% Confidence Interval
Exploratory (continued)					
<u>Mother's health care use at delivery</u>					
Cesarean section delivery (%)	30.2	29.6	0.6	0.729	(-2.3, 3.5)
Cesarean section delivery for nulliparous singleton vertex births ^d (%)	25.3	27.7	-2.4	0.248	(-5.8, 1.0)
Average length of delivery hospitalization ^b (days)	2.95	3.02	-0.07	0.542	(-0.25, 0.12)
Sample size (total = 2,896)	1,569	1,327			

SOURCES: Calculations based on state vital records and Medicaid claims data.

NOTES: Estimates were regression-adjusted using generalized least squares, controlling for pre-random assignment characteristics of sample members and weighted to adjust for differing random assignment ratios used in MIHOPE and MIHOPE-Strong Start. Pre-random assignment characteristics were mean centered and interacted with the treatment variable to reduce the potential for bias since the sample was not randomized in equal numbers to the program and control groups.

See Appendix D for descriptions of the outcome measures used.

^aThe p-value indicates the likelihood of estimating an impact of this magnitude or larger if the intervention had zero effect.

^bThis measure only accounts for health care use paid for by Medicaid.

^cSmall for gestational age and large for gestational age are measured by combining obstetric estimates of gestation and birth weight. Small for gestational age indicates a birth weight below the 10th percentile for gestational age, gender, race/ethnicity, and plurality. Similarly, large for gestational age indicates a birth weight above the 90th percentile.

^dThis measure is among sample members with a nonbreach, first-time, singleton birth.

Confirmatory Outcomes of Low Birth Weight, Preterm Birth, and NICU Admission

Home visiting did not significantly decrease the rates of low birth weight or preterm birth. As Table 4.3 shows, 11.7 percent of births in the program group were low birth weight, compared with 11.6 percent in the control group. The rate of preterm birth was higher in the program group than in the control group (10.6 percent versus 9.4 percent, respectively), but this difference is not statistically significant.

Home visiting did not affect rates of admission to a NICU. Although infants in the program group were admitted to the NICU slightly more often than those in the control group (10.1 percent versus 9.2 percent, respectively), this difference is not statistically significant. The lack of a significant difference between the program and control groups

for NICU admissions is consistent with small differences and lack of statistically significant findings for low birth weight and preterm births.

Compared with the national population, the control group had higher rates of low birth weight and NICU admissions. Specifically, the national rate of low birth weight was 8.1 percent in 2015,³⁸ and NICU admission was 7.8 percent nationally.³⁹ These indicators may reflect the fact that home visiting programs target women at relatively high risk of adverse birth outcomes. On the other hand, the rate of preterm birth for the control group (9.4 percent) was similar to the national average in 2015 of 9.6 percent.⁴⁰

Exploratory Birth Outcomes and Health Care Events

Fourteen exploratory outcomes were examined to assess the impacts of home visiting on birth outcomes and health care at delivery. Among these outcomes, impact estimates are typically small and most estimates (9 out of 14) are not statistically significant.

Although there are no statistically significant impacts on the three confirmatory outcomes shown in Table 4.3, the five exploratory outcomes with statistically significant impacts show a surprising pattern of worse birth outcomes for program group families. For example, program group infants were significantly more likely to be very low birth weight than were control group infants (2.7 percent vs. 1.6 percent), and significantly more likely to have been born very preterm (2.6 percent vs. 1.6 percent) and, by extension, slightly earlier in the mother's pregnancy on average (38.4 weeks vs. 38.6 weeks). Two exploratory outcomes also suggest increased health care use at birth among infants in the program group: Infants in the program group spent more days in the NICU on average than infants in the control group, and infants in the program group spent more days hospitalized at birth on average than infants in the control group, which isn't surprising given that the former were more likely to be born preterm. Although some of these differences are small, the pattern of worse birth outcomes for program group families might warrant additional research to understand whether they are real effects stemming from home visiting.

³⁸Martin et al. (2017).

³⁹Harrison and Goodman (2015). The national NICU admission rate is from 2012 birth record data.

⁴⁰Martin et al. (2017).

Impacts on Breastfeeding Initiation and Medicaid-Paid Health Care Use in First Year After Birth

Table 4.4 presents the estimated effects on breastfeeding at discharge from the hospital and Medicaid-paid health care use in the 12 months after birth. No statistically significant impacts were found on the four confirmatory outcomes: whether the infant was breastfed at discharge, whether the infant had at least one ED visit, whether there was a hospitalization after the birth stay, and the average number of well-child office visits.⁴¹ As previously mentioned, the outcomes presented include only Medicaid-paid health care use. About 80 percent of infants and 90 percent of mothers were enrolled in Medicaid for at least some time after birth, and about 65 percent of infants and 56 percent of mothers were enrolled in Medicaid for the full follow-up period.

Breastfeeding at Time of Discharge from the Hospital

This study found no statistically significant effect of home visiting on the percentage of infants being breastfed at hospital discharge, based on birth records data. In the program group, 78.7 percent of infants were breastfed at discharge — slightly higher than the rate for the control group (78.1 percent) and somewhat higher than a national estimate of breastfeeding initiation among Women, Infants, and Children (WIC) recipients (71.0 percent).⁴² Studies of low-income women have noted both structural and sociocultural barriers to breastfeeding. These include worries about returning to work (particularly in low-skill job sectors that do not support or allow breastfeeding mothers space and time to pump) and constraints on time.⁴³ Other research has found that issues related to the privacy and stigma of breastfeeding in certain contexts are salient factors.⁴⁴ Finally, MIHOPE-Strong Start was limited to examining this short-term measure of breastfeeding (at discharge from the hospital) because that is all that was available on birth certificates. Home visiting could potentially affect the duration of breastfeeding,⁴⁵ an issue that is examined in the Mother and Infant Home Visiting Program Evaluation (MIHOPE).

⁴¹For the binary confirmatory outcomes — breastfeeding at hospital discharge, whether the infant had an ED visit in the first year, and whether the infant had a nonbirth hospitalization in the first year — Table 4.4 presents results based on linear regressions. Results from logistic regression are very similar to those presented in Table 4.4 and are shown in Appendix Table E.4.

⁴²Thorn et al. (2018). This information is based on the U.S. Department of Agriculture's Food and Nutrition Service (FNS) data on breastfeeding initiation for 6- to 13-month-old infants and children served by state WIC agencies in April 2016.

⁴³Guttman and Zimmerman (2000); Haider, Jacknowitz, and Schoeni (2003).

⁴⁴Guttman and Zimmerman (2000).

⁴⁵Feltner et al. (2018).

Table 4.4
Effects on Breastfeeding Initiation and Medicaid-Paid Health Care Use
in the First Year After Birth

Outcome	Program Group	Control Group	Difference (Impact)	P-Value ^a	90% Confidence Interval
<u>Confirmatory</u>					
<u>Breastfeeding initiation</u>					
Infant was breastfed at hospital discharge (%)	78.7	78.1	0.6	0.749	(-2.5, 3.7)
<u>Infant health care use</u>					
Any emergency department (ED) visits (%)	51.3	51.8	-0.5	0.786	(-3.5, 2.5)
Any nonbirth hospitalizations (%)	5.5	6.7	-1.2	0.177	(-2.8, 0.3)
Average number of well-child office visits	3.67	3.71	-0.04	0.707	(-0.19, 0.12)
<u>Exploratory</u>					
<u>Infant health care use</u>					
Average number of ED visits	1.35	1.48	-0.13	0.079	(-0.25, -0.01)
Average number of nonbirth hospitalizations	0.07	0.08	-0.01	0.412	(-0.03, 0.01)
Average length of nonbirth hospitalization (days)	0.58	0.36	0.22	0.142	(-0.03, 0.48)
Compliance with recommended number of well-child office visits ^b (%)					
0-50	41.0	43.5	-2.5	0.151	(-5.3, 0.4)
51-75	26.9	25.9	1.0	0.534	(-1.7, 3.8)
More than 75	32.0	30.6	1.4	0.394	(-1.3, 4.2)
Any immunizations (%)	70.6	70.2	0.4	0.815	(-2.2, 3.0)
Average number of immunizations	8.23	8.07	0.15	0.575	(-0.30, 0.61)
<u>Infant health coverage</u>					
Average proportion of days enrolled in Medicaid between birth and first year					
Fully enrolled (%)	65.4	64.3	1.1	0.500	(-1.6, 3.8)
Partially enrolled (%)	13.6	14.3	-0.7	0.587	(-2.8, 1.4)

(continued)

Table 4.4 Effects on Breastfeeding and Health Care Use in the First Year (continued)

Outcome	Program Group	Control Group	Difference (Impact)	P-Value ^a	90% Confidence Interval
<u>Exploratory (continued)</u>					
<u>Maternal health care use</u>					
Had postpartum visit or postpartum bundled service ^c (%)	34.8	33.9	0.9	0.583	(-1.8, 3.6)
Any ED visits (%)	38.8	40.5	-1.7	0.311	(-4.5, 1.1)
Average number of ED visits	1.02	1.17	-0.14	0.072	(-0.27, -0.01)
<u>Maternal health coverage</u>					
Average proportion of days enrolled in Medicaid	72.7	71.5	1.2	0.283	(-0.6, 3.0)
Fully enrolled (%)	56.8	55.3	1.6	0.319	(-1.0, 4.2)
Partially enrolled (%)	33.1	33.7	-0.7	0.689	(-3.4, 2.1)
Sample size (total = 2,896)	1,569	1,327			

SOURCES: Calculations based on state vital records and Medicaid enrollment and claims data.

NOTES: Estimates were regression-adjusted using generalized least squares, controlling for pre-random assignment characteristics of sample members and weighted to adjust for differing random assignment ratios used in MIHOPE and MIHOPE-Strong Start. Pre-random assignment characteristics were mean centered and interacted with the treatment variable to reduce the potential for bias since the sample was not randomized in equal numbers to the program and control groups.

See Appendix D for descriptions of the outcome measures used.

^aThe p-value indicates the likelihood of estimating an impact of this magnitude or larger if the intervention had zero effect.

^bCompliance with well-child office visit frequency is measured according to the American Academy of Pediatrics and accounts for variations in enrollment periods among mothers. This count includes visits under Medicaid's Early and Periodic Screening, Diagnostic, and Treatment benefit. The measure is constructed through the ratio of the number of visits during an enrollment period and the number expected during that period.

^cTimely postpartum or postpartum bundled service is measured according to the Healthcare Effectiveness Data and Information Set. The measure includes postpartum visits for a pelvic exam or postpartum care on or between 21 and 56 days after delivery.

Infant Health Care Use in the First Year After Birth

About half of the infants had an ED visit during the first year and, among that group, there was an average of three visits, indicating that some babies received care in the ED relatively frequently. This is not uncommon among this demographic group.

National-level data reveal that about one-third of children under 5 years old with Medicaid coverage used the ED in a given year, according to the Medicaid and CHIP Payment and Access Commission.⁴⁶ Additionally, infants use the ED more than other children.⁴⁷

Only about 7 percent of control group infants were hospitalized in the first year and a similarly low rate was observed in the program group (6 percent). These rates are lower than those found in the two prior HFA studies, which also did not find statistically significant differences between the program and control groups. Specifically, the HFA evaluation in Hawaii found that rates of hospitalization for any reason in the first year were about 18 percent for both research groups.⁴⁸ In the HFA Alaska evaluation, about 40 percent of both program and control group children were hospitalized for any reason in the first two years of life (based on self-reports and verified with medical records).⁴⁹ Other studies of home visiting have evaluated hospitalizations but focused on those related to injuries or ingestions, as some of these cases may be preventable and possibly related to maltreatment.

The difference in any ED visits between the program and control groups is small and not statistically significant. However, there was a statistically significant reduction in the number of ED visits (an exploratory outcome) for program group children in the first year. This suggests that home visiting programs might be helping families avoid multiple ED visits during that year, but since this outcome is exploratory, it warrants further research.

Although the programs did not increase the number of well-child visits paid for by Medicaid, there may be room for improvement in this outcome. Most infants in the study appear to have received fewer than the number of visits recommended by the American Academy of Pediatrics for the child's age.⁵⁰ This may be why ED use was higher for MIHOPE-Strong Start families than nationally. It is not uncommon for a Medicaid-covered population to fall short in their well-child visit attendance. For example, only 47 percent of Medicaid-covered patients in four urban pediatric practices in

⁴⁶Medicaid and CHIP Payment and Access Commission (2016).

⁴⁷Wier, Yu, Owens, and Washington (2013).

⁴⁸Duggan et al. (1999).

⁴⁹Caldera et al. (2007).

⁵⁰The recommended number is based on the child's age and the length of available follow-up data, but it includes visits at three to five days and in months 1, 2, 4, 6, 9, and 12 (the newborn checkup is assumed to have occurred in the hospital).

Philadelphia had at least five visits by 12 months of age.⁵¹ Additionally, the Medical Expenditure Panel Survey (MEPS) shows that publicly insured children received only 57 percent of the recommended number of well-child visits on average from 2007 to 2008.⁵²

It is important to note that the results shown in Table 4.4 understate the actual use of well-child visits since they exclude visits that were not paid for by Medicaid. After limiting the sample to infants enrolled in Medicaid for the full year after birth and those for whom 12 months of follow-up data on service use were available, the well-child adherence rate improves: Overall, 44 percent of infants attended more than 75 percent of recommended visits, 37 percent attended between 51 percent and 75 percent, and only 19 percent went to 50 percent or fewer (not shown in any table; no statistically significant differences by research group).

Maternal Health Care Use in the First Year After Birth

Home visiting did not have statistically significant impacts on exploratory outcomes related to the mother's health care use in the first year after birth (with one exception being the average number of ED visits). Similar to infants' health care use patterns, mothers' use of the ED was relatively high, with about 40 percent of the full sample having at least one ED visit, which is consistent with national estimates of the percentage of nonelderly adults enrolled in Medicaid (approximately 40 percent) but higher than the percentage of privately insured adults (approximately 17 percent).⁵³ On the other hand, receipt of preventive care was low: Only about one-third of mothers had a postpartum visit. However, the postpartum visit rate increases to 42 percent among mothers who had Medicaid coverage for the full follow-up period (1,703 mothers; not shown). Among women with Medicaid coverage nationally, the median rate of receiving postpartum care was 58 percent in fiscal year 2016 among the 34 states using Adult Core Set specifications to report this measure.⁵⁴ Only one previous HFA or NFP study, HFA Oregon, has examined mothers' ED use after birth, and it did not find any statistically significant impacts.⁵⁵

⁵¹Van Berckelaer, Mitra, and Pati (2011).

⁵²Abdus and Selden (2013).

⁵³Garcia, Bernstein, and Bush (2010).

⁵⁴Centers for Medicare and Medicaid Services (2017).

⁵⁵Green et al. (2016).

Estimated Impacts, Analyzed by Family Subgroup

Although the results thus far suggest home visiting did not improve birth and related outcomes overall, the programs might have had greater effects for some families. MIHOPE-Strong Start investigated this possibility by estimating impacts for the eight confirmatory outcomes across prespecified subgroups of families defined by four risk factors: (1) race and ethnicity,⁵⁶ (2) trimester of pregnancy when randomly assigned, (3) whether the mother smoked prior to pregnancy, and (4) maternal age. These risk factors were chosen because they are associated in the literature with birth outcomes or because they have been examined in past studies of home visiting. For example, the NFP Elmira study found impacts on birth outcomes for smokers but not for nonsmokers. The finding by the Elmira study that NFP reduced maternal smoking suggests that home visiting may have greater effects on birth outcomes for smokers by helping them to reduce how much they smoke. Likewise, effects are expected to be larger for mothers who enrolled earlier in pregnancy since there is more time for home visiting to make a difference in the baby's birth.

This study finds little evidence that home visiting was more effective at improving any of the confirmatory outcomes (low birth weight, preterm birth, NICU admission, smoking during third trimester, breastfeeding at hospital discharge, any infant ED visits in the first year, any infant hospitalizations in the first year, and the average number of well-child office visits) for any of the family subgroups (see Appendix Table F.1 through Appendix Table F.4). Five out of the fifty-six subgroup comparisons are statistically significant, which is similar to what would be expected if there were no true differences across subgroups.⁵⁷ In addition, the differences that are statistically significant run counter to expectations. For example, impacts on preterm birth and NICU admission are significantly worse for smokers than for nonsmokers, which goes against expectations and evidence from the NFP Elmira study. Likewise, the estimated effects on preterm birth are worse for mothers who enrolled earlier in their pregnancies, which is contrary to the expectation that home visiting should have larger effects for those who are in the program longer.

⁵⁶To examine impacts by race and ethnicity, families were divided into the following groups: (1) non-Hispanic white, (2) non-Hispanic black, (3) Hispanic of Mexican origin, (4) other Hispanic, and (5) other/multiracial. Since the literature on health disparities typically compares results for minority group members with results for white individuals, Appendix Table F.1 compares white sample members with each minority group.

⁵⁷Since adjustments are not typically done for exploratory findings, the study's analysis plan did not include an explicit adjustment for the subgroup results. However, applying an adjustment according to Benjamini and Hochberg (1995) indicates that none of the subgroup differences are statistically significant after accounting for the number of comparisons.

There are few subgroup findings in previous studies with which to compare the current findings, so the patterns in effects across family subgroups for some of the main outcomes examined in MIHOPE-Strong Start represent the only estimates to date. If other studies had found similar patterns in the subgroup findings for the confirmatory outcomes, it would bring more evidence to bear on the interpretation of the MIHOPE-Strong Start findings. As noted, there is little evidence, taking into consideration the number of subgroups and outcomes examined, that home visiting programs in the study had differential effects for different families. Additional studies of home visiting are needed to shed more light on whether the few differences that were found are real or spurious.

How Impacts Vary Across Local Programs and with Dosage

Beyond estimating the impacts of home visiting on key birth-related outcomes for the full sample and for subgroups of families, MIHOPE-Strong Start's design included many local home visiting programs in order to be able to examine how impacts varied across them. For this analysis, the study sought to address three broad questions:

- How much do impacts vary across local home visiting programs?
- Are the features of local home visiting programs (including which evidence-based model they use) related to their effects on family outcomes?
- Are impacts larger in local programs where families receive more home visits and referrals?

What follows is a summary of the results of this analysis. Detailed results are presented in Appendix G.

- **For the study's eight confirmatory outcomes, impacts vary little across local programs.** Although estimated impacts do vary across local programs, they vary no more than one would have expected by chance alone. This means there is little evidence that certain local programs are improving birth outcomes much more than the average program presented earlier in the chapter.
- **Estimated effects vary somewhat by evidence-based model, but these differences are not statistically significant.** As discussed in Chapter 1, HFA and NFP shared many goals and methods, but they also differed in several respects, such as which families they aim to

serve, the credentials they require of home visitors, and the extent to which they prioritize prenatal care. However, the analysis did not find significant differences in impacts between the two evidence-based models, nor are impacts systematically more positive for one model than the other.

- **Impacts do not generally vary with local program features, but there are some indications that the local health care environment might be related to impacts.** The analysis investigated whether there are differences in impacts based on home visitor experience, the frequency with which supervisors observe home visits, home visitor case-load, and whether the local program has a staff member dedicated to continuous quality-improvement activities. These program features were chosen because they vary substantially across local programs and there are strong hypotheses about how they might improve family outcomes. However, the results do not suggest that local programs with strong implementation characteristics produce larger effects than other local programs. The analysis also examined how impacts vary with the density of primary care physicians in the community. Two results are intriguing: Local programs located in areas with a higher density of primary care physicians had greater reductions in low birth weight births than other local programs, and such programs are associated with greater reductions in infant ED visits than other local programs.
- **Local programs that provided families with more home visits and more referrals did not have significantly larger effects on families than other local programs.** The study team also investigated the relationship between the home visiting services received and the impacts. Measures of home visiting services include the number of home visits,⁵⁸ whether the mother received a referral for services related to each specific outcome,⁵⁹ and whether the mother received a referral

⁵⁸The number of home visits was limited to the prenatal period for birth outcomes, smoking during the third trimester, breastfeeding initiation, and NICU use.

⁵⁹Whether any referral was made for breastfeeding, infant feeding, and nutrition in the prenatal period (one measure) was included for examining impacts on attempted breastfeeding before hospital discharge. Whether any referral was made for prenatal care was included for examining low birth weight, preterm birth, and NICU use. Whether any referral was made after birth for child preventive care was included for examining impacts on well-child visits, child ED visits, and child hospital admissions besides the one at birth.

for mental health services in the prenatal period. The last was included for all eight confirmatory outcomes since maternal mental health could have effects across a wide range of outcomes.

A concern about investigating the link between services and impacts is that service receipt may vary with family outcomes even if the services received do not cause those outcomes to be larger or smaller. Mothers who participate have to agree to schedule visits, let the home visitor into their home, and spend time with the home visitor. It is likely that the mothers who benefit the most from home visits are those who are most engaged in the program and remain enrolled in the program over a longer period of time as a result. Larger impacts for such mothers would not necessarily mean that increasing the number or length of home visits for other mothers would lead to similar improvements in their family's outcomes. From a different perspective, it is possible that mothers who can schedule and keep multiple appointments with a home visitor may have better parenting skills, be better able to navigate the health care system, and be more likely to delay having their next child than other parents. Such parents might not actually benefit much from the program, and impacts might be smaller for them than for other mothers.

Because of this uncertainty, the current analysis is based on how service receipt and impacts varied across local programs and does not examine the relation between service receipt and impacts at the individual family level.⁶⁰ The analysis did not find significantly larger impacts in local programs where families received more home visits or were more likely to receive referrals for community services.

Conclusion

No statistically significant estimated effects were found on any of the eight confirmatory outcomes analyzed in relation to the prenatal period, the time of birth, and the child's

⁶⁰An instrumental variable analysis was used in which randomization within each local program served as an instrument for estimating the relationship between impacts, the number of home visits, and referral rates. In essence, this method examines how local program impacts vary with the average number of home visits families in the program receive and the percentage of program group families who receive referrals. Appendix G contains more details about this analysis. Note that analyses that examine the relationship between impacts and dosage at the family level were not conducted.

first year. There are a handful of exploratory outcomes for which statistically significant differences were found between research groups, but these impacts were observed in both directions (that is, sometimes the program group members were better off than the control group members, and at other times they were worse off).

One reason the home visiting programs studied in MIHOPE-Strong Start might not have been effective in improving birth outcomes is that there was little room for improvement in maternal risk factors, because the control group did well even without the help of home visiting. For example, only 10 percent of mothers reported smoking in the third trimester and over 80 percent of mothers were reported to have adequate prenatal care. These are better rates than seen in prior studies of home visiting and are consistent with national trends as well as the possible effects of Medicaid expansions under the Affordable Care Act. For example, smoking has declined over time in the United States, and the percentage of women receiving late or no prenatal care has also declined substantially over time.⁶¹ While it is unclear whether Medicaid expansions have increased the use of prenatal care, researchers have found that the Affordable Care Act led to increased use of primary care.⁶² In addition, among the subset of families for whom information was available, more than 75 percent were receiving WIC or Supplemental Nutrition Assistance Program support at study entry, which suggests that these families were already accessing important nutritional assistance as well as receiving screenings, referrals, and nutrition education and counseling provided by WIC that could mitigate the risk of poor birth outcomes.

At the same time, the results point to some areas in which home visiting programs could perhaps do more. In particular, the use of the EDs in the study was high and the use of preventive care was lower than recommended. Both of these are areas that the Centers for Medicare and Medicaid Services has identified as components of quality care that it seeks to improve.

In addition, it is important to remember that the effects of home visiting on birth and related outcomes in previous studies were inconsistent or relevant to only subgroups of families. Thus, the current study provides new evidence that, for the women enrolled in the local programs analyzed in this study, home visiting did not have a substantial effect on birth outcomes. The low rates of risky behavior among participants raise the question of whether home visiting programs might be better able to improve birth outcomes if they were to target families or communities in which smoking was more problematic and the receipt of public food assistance and adequate prenatal care were

⁶¹Jamal et al. (2016); Child Trends DataBank (2015).

⁶²Courtemanche et al. (2017).

less prevalent. In addition, it should be noted that home visiting programs have demonstrated effects on a range of other outcomes not examined in the current study, such as parenting, child development, and family economic self-sufficiency. This wider set of outcomes is examined in MIHOPE.⁶³

⁶³Michalopoulos et al. (2019).

Chapter 5

Conclusion

The Mother and Infant Home Visiting Program Evaluation-Strong Start (MIHOPE-Strong Start) examined the effects of home visiting on improving birth outcomes as well as on prenatal health and health care use during infancy. The study was motivated by several considerations. First, the consequences of poor health at birth are considerable in their implications for a child's future health and cognitive development, alongside medical care and financial costs.¹ Second, disparities in the risk of adverse birth outcomes along racial, ethnic, and socioeconomic lines exacerbate existing and persistent disparities in health and well-being over the life course.² Third, there has been limited progress over the past several decades in reducing the risk of poor health at birth among those families at greatest risk, despite advancements in medicine and improved access to health care.³ These factors have led health experts and decision makers to look to other types of interventions that could potentially address the multifaceted nature of risk that low-income expectant mothers often face. The home visiting models examined in MIHOPE-Strong Start represent one such strategy. They are but one among multiple models being used under the Center for Medicare and Medicaid Innovation's Strong Start for Mothers and Newborns Initiative, which evaluated whether enhanced, nonmedical prenatal interventions, when provided in addition to routine medical care, have the potential to improve birth outcomes and reduce health care costs for women enrolled in Medicaid.

It is important to note that prenatal health, healthy births, and preventive health care for infants are a subset of the outcome areas that evidence-based early childhood home visiting programs included in this study aim to affect. In addition to the outcomes examined in MIHOPE-Strong Start, these home visiting programs aim to promote positive parenting practices, child development, and family economic self-sufficiency and to prevent child maltreatment and family violence. MIHOPE-Strong Start thus represents an examination into only part of what early childhood home visiting is trying to accomplish. In MIHOPE, a wider set of outcomes targeted by early childhood home visiting programs and two additional evidence-based models were examined. Furthermore,

¹Institute of Medicine (U.S.) Committee on Understanding Premature Birth and Assuring Healthy Outcomes (2007).

²Conley and Bennett (2000); Institute of Medicine (U.S.) Committee on Understanding Premature Birth and Assuring Healthy Outcomes (2007).

³Kramer, Seguin, Lydon, and Goulet (2000); Institute of Medicine (U.S.) Committee on Understanding Premature Birth and Assuring Healthy Outcomes (2007); Lu et al. (2010).

home visiting programs are only one part of states' initiatives to try to improve prenatal health, healthy births, and preventive health care.⁴

The relatively large-scale examination produced by MIHOPE-Strong Start provides new evidence about the effects of home visiting programs using two evidence-based models — Healthy Families America (HFA) and Nurse-Family Partnership (NFP) — on birth outcomes as well as on prenatal health and health care use in infancy. The key findings from this study are as follows:

- **Local home visiting programs in the study did not significantly decrease rates of low birth weight or preterm birth.** Specifically, 11.7 percent of births in the program group were low birth weight, compared with 11.6 percent of births in the control group. Although the rate of preterm birth was higher in the program group than in the control group (10.6 percent versus 9.4 percent, respectively), this difference is not statistically significant.
- **The home visiting programs in the study did not significantly affect the percentage of infants admitted to a neonatal intensive care unit.** This is consistent with the small impacts on low birth weight and preterm birth risk.
- **The home visiting programs in the study did not significantly change health-related behaviors or health care use in the first year.** Measures of health-related behaviors examined in this study include smoking in the last trimester of pregnancy and initiating breastfeeding. Measures of health care use in this study include the average number of well-child visits received by infants in the first year, whether mothers had any emergency department (ED) visits during pregnancy or in the first year after birth, and whether infants had any ED visits or hospitalizations in the first year of life.
- **Home visiting programs' effects do not differ across different subgroups of families in the study.** Examining impacts for subgroups defined by maternal race and ethnicity, maternal age, trimester of study entry, and maternal smoking suggests that home visiting did not improve outcomes for different types of families.

⁴Sparr et al. (2017). Available at: <https://www.acf.hhs.gov/opre/resource/promoting-prenatal-health-and-positive-birth-outcomes-a-snapshot-of-state-efforts>.

- **The effects of home visiting do not vary across local programs in the study.** Impacts on prenatal health, birth outcomes, and health care use in infancy do not differ between the evidence-based models or according to how local programs were implemented.

In the following sections, the study team reviews the strengths and limitations of the study's design and findings. The discussion then turns to several possible explanations for the lack of positive program effects. Last, there is a discussion of putting the study results in the context of the broader literature on home visiting effectiveness and on the determinants of adverse birth outcomes.

Study Strengths and Limitations

MIHOPE-Strong Start represents the largest randomized controlled trial to date to examine whether home visiting improves birth outcomes. Since low birth weight and preterm birth are relatively uncommon events, a large sample was required to detect small program effects with statistical certainty. Thus, with a sample of 2,900 mothers, MIHOPE-Strong Start was designed to detect a reduction of 2.8 percentage points for the outcome of low birth weight and a reduction of 2.5 percentage points for the outcome of preterm birth. The impacts estimated by MIHOPE-Strong Start are much smaller than these levels — 0.1 percentage point and 1.1 percentage point, respectively — and are not statistically significant.

In addition to using a large sample to evaluate relatively rare poor birth outcomes, MIHOPE-Strong Start adds to the knowledge base and literature about the effects of home visiting by including a diverse sample of women residing in 17 states. The sample was drawn from local home visiting programs that use one of two evidence-based models — HFA or NFP — that prioritize improving maternal health in pregnancy and reducing poor birth outcomes. MIHOPE-Strong Start also collected a rich set of data that made it possible to examine how home visiting is related to birth outcomes and maternal and infant health through multiple lenses, including:

- **service delivery findings** (including multivariate analyses of the family, home visitor, and local program characteristics associated with the differences in the number of home visits received and the duration of service receipt)
- **a main impact analysis at multiple points in time** (during pregnancy, at birth, and in the first year after birth)

- **sensitivity tests** (to validate the findings presented in the main impact analysis)
- **exploratory subgroup analyses** (to examine whether program effects differ based on maternal risk factors for poor birth outcomes)

MIHOPE-Strong Start also relied on administrative data — specifically vital records and Medicaid enrollment and claims data — as follow-up data, which could make the findings of this study relatively easy to replicate in other studies of home visiting by allowing them to collect similar data and measure outcomes in the same way that MIHOPE-Strong Start did.

As with all evaluations, the estimates from MIHOPE-Strong Start are specific to this sample of local programs and families, which, while racially, ethnically, and geographically diverse, is not technically a nationally representative sample. MIHOPE-Strong Start was conducted primarily in urban contexts, even though home visiting also operates in many rural areas. Since rural areas tend to have fewer health care resources, it is possible the effects of home visiting would be different in those locations. Furthermore, when the study began in 2012, the Maternal, Infant and Early Childhood Home Visiting (MIECHV) program had recently been launched.⁵ Many (57) of the local programs included in MIHOPE-Strong Start received some funding from the MIECHV program, which created changes in local program prioritizations and program monitoring requirements that might have resulted in their implementation evolving over time.⁶ The findings here should be understood within this broader implementation and policy context.

The MIHOPE-Strong Start impact analysis compared outcomes for all program group and control group families,⁷ even though 14 percent of program group families received no home visits. Since 86 percent of families assigned to the program group received at least one home visit, the effects would be only about 16 percent larger if the analysis had estimated the effects among families who received at least one home visit,

⁵Michalopoulos et al. (2015).

⁶Duggan et al. (2018).

⁷This is the same method that was used in earlier HFA and NFP trials that found improvements in birth outcomes (Lee et al., 2009; Olds, Henderson, Tatelbaum, and Chamberlin, 1986). As discussed in Chapter 1 and Chapter 4, it is also considered standard practice for a random assignment study because it preserves the similarity between the program and control groups that is generated by randomization.

and the conclusions based on statistical significance would be unaltered.⁸ Although the amount of home visiting might matter, the study did not find systematically larger effects in local programs where the number of home visits received was higher than in local programs reporting fewer visits.⁹

It should be noted that while there are advantages of using administrative data for measuring outcomes, there are also limitations. For example, it is known that the information provided on birth records about the mother's smoking is underreported.¹⁰ Thus, the smoking outcomes examined are likely underestimates of true prevalence. Since research on smoking cessation programs has found greater underreporting for those who have attended a program — presumably because they are more aware of the negative impacts of smoking or because they more acutely feel the stigma associated with smoking — it is possible that the bias toward the underreporting of smoking is of greater concern among program group women in MIHOPE-Strong Start as well.¹¹ If such a bias occurred, however, it would have inflated the impact estimates, making it more likely for the study to find reductions in smoking among the program group compared with the control group — but the study did not find such reductions.

Relatedly, because the study used data from birth records to examine rates of breastfeeding, it lacks information on breastfeeding duration. Initiation of breastfeeding is an important public health goal, but for the infant to receive the protective immunological benefits from breast milk, an extended duration of breastfeeding is recommended. Leading health organizations recommend that infants be breastfed for at least 12 months, and estimates at the national level suggest that breastfeeding mothers with lower socioeconomic status wean earlier than mothers with higher socioeconomic status.¹² Thus, while breastfeeding duration is a meaningful outcome to consider, data limitations preclude its examination in this study.

⁸For a given impact equal to 1 for the full sample, the impact for the 86 percent of program group families who received at least one home visit can be estimated by dividing the full-sample impact by 0.86. This assumes the impact is 0 for the 14 percent of program group members who received no home visits. As a result, the impact among those who received a home visit is about 16 percent ($1 / 0.86$) larger than for the full sample.

⁹Similar patterns were observed in which systematically larger effects were not found based on the duration of services provided and whether a referral was made for prenatal health or maternal physical health during pregnancy.

¹⁰Curtin and Mathews (2016).

¹¹For example, a study of a smoking cessation intervention by Kendrick et al. (1995) found a reduction in smoking when measured by self-reports but not when measured through urine samples.

¹²American Academy of Pediatrics (2012); Anstey, Chen, Elam-Evans, and Perrine (2017).

It is also important to keep in mind that the measure of the adequacy of prenatal care use included in this study does not address the *quality* of health care received in health care visits. Likewise, the service delivery measures examined in the implementation analysis — including the amount of home visiting and duration of participation — capture aspects that are distinct from the quality of home visiting services received.

For outcomes related to health care use in the infant's first year, effects on Medicaid-paid health care were estimated for the full sample. Because some families were not covered by Medicaid for the full year and some could not be matched to Medicaid data, the estimates are likely to understate the effects of home visiting on Medicaid-covered health care. However, enrollment patterns were similar between the program and control groups and estimated effects are quite small, so this shortcoming is unlikely to have altered the study's conclusions. In addition, because MIHOPE-Strong Start did not collect information on families' health care not covered by Medicaid, it is impossible to know from the current study whether or how home visiting altered health care use for those not covered by Medicaid.

Common Explanations for the Lack of Program Effects

In the broader literature on replicating program effects, there are several common theories as to why a new trial produces different results from those of the original trial. These include (1) issues with program implementation; (2) differences in who was included across different studies; (3) reduced service contrast (that is, differences between services received by the program and control groups); and (4) issues with study design and execution. Since the sample's attrition was minimal in MIHOPE-Strong Start and similar information was available for program and control group families, the discussion below provides context for interpreting the study's impact results as they relate to findings from the implementation analysis, characteristics of the sample, and service contrast.

Program Implementation

One common explanation for a lack of program impacts is problematic implementation. However, this does not seem to be a likely explanation for the small impacts found in MIHOPE-Strong Start. First, the study team recruited local programs that were in good standing with their evidence-based model developer and had at least two years of operational experience. The model developers also monitor local program implementation to ensure that fidelity to the model is maintained.

In addition, the MIHOPE-Strong Start implementation research found that programs reported that they were, on the measures available, generally well implemented. For example, most local program managers and home visitors placed a high priority on improving prenatal health and birth outcomes, and local programs reported that they had infrastructure in place to support those priorities. While organizational goals at upper management levels can sometimes get lost in translation among front-line staff members, most home visitors said they were supported by their program, with adequate training, useful supervision, and helpful tools and strategies, in working with families to improve the health of the mother during pregnancy and later her infant.

While MIHOPE-Strong Start examined a more comprehensive set of program characteristics than did previous studies of home visiting and birth outcomes, additional unexplored measures may be equally important for understanding the strength of implementation. These include the quantity, modality, and content of training; the type of supervision techniques used with home visitors; the broader organizational climate and culture of the implementing organization; and the home visitors' use and reinforcement of particular strategies during home visits. Although such information was not available in MIHOPE-Strong Start, some of these richer data were included and analyzed in the Mother and Infant Home Visiting Program Evaluation (MIHOPE) implementation study.¹³

The levels of service intensity during pregnancy were not as high as specified by the two evidence-based models' standards, but participation levels among families in MIHOPE-Strong Start were similar to those found in previous studies of HFA and NFP, including two of the earlier trials that found positive impacts on birth outcomes for either the full sample or for certain subgroups.¹⁴ Furthermore, women who were more vulnerable to poor birth outcomes, according to most measures of maternal risk factors, received a similar number of home visits and participated in the program for similar lengths of time as women who were less vulnerable. And the impact variation analysis did not find evidence that local programs where families received a higher dosage of home visiting had larger effects than other local programs.¹⁵

¹³Duggan et al. (2018).

¹⁴Lee et al. (2009); Olds, Henderson, Tatelbaum, and Chamberlin (1986). The other trial (NFP Orange County) to have found significant positive effects on improving birth outcomes (Nguyen, Carson, Parris and Place, 2003, as reported in Miller, 2015) did not describe the actual dosage received by the program group.

¹⁵The impact variation analysis did not consider variation in service receipt at the family level (that is, across families served by each local program) and some families received very few home visits or none at all.

This is not to say that dosage, or a dosage level that is closer to the models' expectations, does not matter, but rather that it remains unclear whether an increased level of services would have led to larger effects on birth outcomes. Future work could examine whether new approaches to program implementation or service design would improve sustained family engagement in home visiting during pregnancy and, in turn, whether this would increase the effectiveness of the programs in improving birth outcomes.

Characteristics of the Sample

The families in MIHOPE-Strong Start, while disadvantaged in their sociodemographic characteristics and on some other indicators, were not particularly high risk in their health behaviors, access to nutritional forms of support, or access to health care. On these indicators, as discussed below, there was limited room for home visiting to make a difference among the sample.

Smoking was not highly prevalent in either the program group or the control group at study entry, and smoking rates were much lower than in two of the three prior HFA and NFP trials that showed positive impacts on birth outcomes for either the full sample or for certain subgroups.¹⁶ The smoking rate among MIHOPE-Strong Start sample members was very similar to the smoking rates among women in the NFP Memphis trial, which also did not find any effects on low birth weight or preterm birth. In fact, the study authors of the NFP Memphis trial pointed to the marked differences in smoking prevalence between the NFP Memphis sample and the NFP Elmira sample (the percentages of mothers who smoked at least one cigarette per day at study intake were 9 percent and 55 percent, respectively) as a potential reason for the differences in impact results.¹⁷

In addition, 64 percent of families for whom information was available in this study reported receiving benefits from the Women, Infants, and Children (WIC) program at baseline.¹⁸ This is not surprising considering that the WIC program is a common source of referrals for recruitment of families into home visiting (72 percent of local programs reported receiving referrals into their programs from their local WIC office). Given

¹⁶The third trial (of NFP in Orange County) to have found positive impacts on improving birth outcomes (Nguyen, Carson, Parris and Place, 2003, as reported in Miller, 2015) did not publish any information on smoking behavior during pregnancy.

¹⁷Kitzman et al. (1997).

¹⁸Information on WIC use was limited to the MIHOPE sample of families who contributed to the MIHOPE-Strong Start analysis.

prior research suggesting that WIC participation leads to improved birth outcomes,¹⁹ the average family was not high risk in this regard. Additionally, WIC staff members are trained to promote breastfeeding and provide breastfeeding support during the prenatal and postpartum periods.²⁰

Further, most mothers reported having a usual source of prenatal care at baseline, and among those who entered the study in the second or third trimester (1,823 women), most had already initiated care in the first trimester, suggesting that the study sample was not disconnected from health care providers. This may be because over 80 percent of local programs in MIHOPE-Strong Start reported that prenatal health clinics were a common source of referrals for the recruitment of families into home visiting. Perhaps for this reason, most control group families received an adequate number of prenatal visits, suggesting that there was little room for improvement on prenatal care visit receipt. Moreover, there is some debate in the broader literature about the extent to which access to and use of prenatal health care is salient for improving birth outcomes. Although prenatal care is certainly important for detecting medical complications and conditions early, trends in improved access to and use of prenatal care among low-income women through Medicaid and Medicaid expansions has not coincided with noticeably decreased rates of low birth weight and preterm birth.²¹

One area for future work could be to examine whether programs would be more effective at improving birth outcomes if they were to target high-risk families, such as mothers who smoke during pregnancy and those who are not connected to the health care system.

Service Contrast

The random assignment design in MIHOPE-Strong Start represents a test of evidence-based home visiting services available from 66 local HFA and NFP programs in comparison with other community-based services that the control group could receive. For MIHOPE-Strong Start, the study team targeted recruitment toward local programs that were located in an environment without other HFA or NFP home visiting services available for control group members in the immediate vicinity. In communities with multiple HFA or NFP programs in operation, the study attempted to include all of them.

¹⁹Bitler and Currie (2005).

²⁰U.S. Department of Agriculture, Food and Nutrition Service (2018).

²¹Kenney et al. (2017); Martin et al. (2017); Medicaid and CHIP Payment and Access Commission (2018).

Yet it is possible that control group families had access to other effective services in the community. As documented in another MIHOPE-Strong Start report, the 17 states included in the study have launched multipronged efforts to promote improved prenatal and newborn health. In addition to evidence-based home visiting, these efforts include initiatives to understand prenatal and infant treatment of neonatal substance exposure, providing Medicaid reimbursement for smoking-cessation services, and promoting the use of long-acting reversible contraceptives.²² MIHOPE-Strong Start did not collect information directly from control group families about their use of other services, and therefore cannot confirm whether or not this contributed to the lack of home visiting effects. However, MIHOPE did collect information on service use among control group families to shed light on this issue. In MIHOPE, about 20 percent of women who were assigned to the control group indicated that they received home visiting or parenting services in the year before completing a follow-up survey, which was conducted around the time the child was 15 months old. Additionally, 9 percent of control group families in MIHOPE received behavioral health services, about 3 percent received intimate partner violence services, and about 4 percent of children received early intervention services. As part of the study protocol, MIHOPE-Strong Start control group families were given information on other types of services in the community, which covered areas such as pregnancy, substance abuse, housing, and food and nutrition; less frequently, they were given information about a home visiting program that was more limited in scope.

Further Context

In addition to the considerations previously described, it is important to contextualize the lack of impacts on birth outcomes within the larger body of research on the determinants of newborn health and the potential effects of home visiting on family outcomes observed over a longer period than one year after birth.

Specifically, insights from research on the epidemiology of newborn health risk would be a pertinent consideration. Scholars have increasingly focused on the role of stress, particularly cumulative exposure to stress, in altering the physiology of the fetal environment among low-income and racial minority women.²³ This research points to an important but more distal mechanism that could affect birth outcomes. The nature of stress, which can be chronic and have long-lasting effects, suggests that interventions

²²Sparr et al. (2017).

²³Kramer, Seguin, Lydon, and Goulet (2000); Institute of Medicine (U.S.) Committee on Understanding Premature Birth and Assuring Healthy Outcomes (2007); Lu et al. (2010).

that occur during pregnancy may not be able to mitigate the cumulative negative impacts of stress on the current birth, even if the intervention begins early during pregnancy.²⁴ But it is also possible that the home visitor's ongoing interactions and supportive role with families could play a part in reducing stress and thereby improve maternal and child health outcomes in the future.

Relatedly, to the extent that the local programs were able to address and improve the mother's health and well-being after the focal child's birth, there may be longer-term impacts of home visiting on future births. Researchers have increasingly emphasized the importance of prepregnancy health and care in improving newborn health.²⁵ Although effects on subsequent births are not commonly examined in the home visiting literature, there is exploratory evidence suggesting that evidence-based home visiting could indeed improve the health of children born after the first child. For example, while the NFP Memphis trial did not find positive impacts on improving birth outcomes for the focal child,²⁶ positive effects on the health of subsequent births were found.²⁷ Several trials of NFP and HFA have also found positive impacts on the spacing between births,²⁸ which, in turn, is related to improved maternal health and better birth outcomes.²⁹

Finally, while MIHOPE-Strong Start examined the relationship between home visiting and birth outcomes observed in 66 local HFA and NFP programs, it should be noted that both of these models have produced positive impacts in important areas beyond the ones examined in this study, including improving positive parenting practices, child development, and the home environment, and reducing child maltreatment.³⁰ Whereas MIHOPE-Strong Start examined newborn health and its associated outcomes during pregnancy and in the following year, MIHOPE investigates a broader set of outcomes, focuses on outcomes after the baby is born, and includes mothers being served by two additional evidence-based models. Thus, the impact analysis of MIHOPE

²⁴Lu and Halfon (2003); Lupien, McEwen, Gunnar, and Heim (2009).

²⁵Atrash et al. (2006); Freda, Moos, and Curtis (2006).

²⁶Kitzman et al. (1997).

²⁷Kitzman et al. (2000).

²⁸Kitzman et al. (1997); Landsverk et al. (2002); Olds et al. (2002). The reduction in the likelihood of experiencing a repeat pregnancy from the HFA San Diego trial (Landsverk et al., 2002) was limited to the subgroup of white mothers.

²⁹Conde-Agudelo, Rosas-Bermudez, Castaño, and Norton (2012).

³⁰A complete list of studies that examined and found positive effects in specific domains can be viewed on the HomVEE study search tool. See <http://homvee.acf.hhs.gov>.

provides additional rigorous information on home visiting effectiveness across other domains.³¹

Further, some important impacts may not emerge until later in the child's life. For example, cost-benefit analyses of evidence-based home visiting have found that program benefits exceed costs to society, including government spending, when the child is school age but usually not earlier.³² Thus, a long-term follow-up study is currently being conducted for MIHOPE in order to explore whether these longer-term effects emerge in the current environment.

³¹Michalopoulos et al. (2019).

³²Michalopoulos, Faucetta, Warren, and Mitchell (2017).

Appendix A

Details on Data Sources and Sample Sizes

As discussed in Chapter 1, the Mother and Infant Home Visiting Program Evaluation-Strong Start (MIHOPE-Strong Start) draws from multiple sources of information. The study team used these sources to describe the families in the study and the communities where families resided, the characteristics of home visiting programs and staff members, and the services delivered to program group families. The study team also used these sources to measure the prenatal, birth, and health care outcomes of interest in the study.

This appendix provides information on the data sources used throughout the report and the analytic sample sizes. Descriptions of data used and sample sizes are organized according to the following categories:

- Family baseline information
- Community characteristics of families
- Healthy Families America (HFA) and Nurse-Family Partnership (NFP) models
- Local program and home visitor characteristics
- Services delivered to program group families
- Information on family outcomes (vital records data and Medicaid or Children’s Health Insurance Program [CHIP] enrollment and use)¹

Details on the particular measures used throughout the report based on these data sources are found in subsequent appendices. The presentation of this information in the appendices follows the order in which it is presented in the main report:

- Appendix B provides more information on specific measures relating to family baseline characteristics, including the community characteristics of families.
- Appendix C provides further information on implementation measures (specifically, the services delivered to families).
- Appendix D provides information on the specific outcome measures used in the impact analysis.

¹Hereafter, “Medicaid” refers to either Medicaid or CHIP.

Data on Family Baseline Characteristics

Information on family characteristics was primarily derived from family baseline surveys. For some characteristics, information was also pulled from study intake data, vital records, and Medicaid enrollment data. Together, these data sources were used to describe the sample at study entry and check for baseline equivalence across research groups. For the implementation analysis, baseline data on program group families were also included in the multivariate examination of services delivered to families. Family baseline data for program and control groups were included in the impact analyses as covariates in order to increase the precision of the impact models and to conduct subgroup analyses.

Family Baseline Surveys

At the time of study entry, telephone interviews were conducted with mothers using either the MIHOPE-Strong Start family baseline survey or the Mother and Infant Home Visiting Program Evaluation (MIHOPE) family baseline survey — depending on whether the family was recruited for MIHOPE-Strong Start or MIHOPE. These two surveys took different lengths of time to conduct and collected slightly different sets of information from respondents. Whereas the MIHOPE family baseline survey was designed to be one hour long, the MIHOPE-Strong Start survey was designed to be much shorter — about 15 minutes long. The MIHOPE survey includes most items on the MIHOPE-Strong Start survey plus many others. Family baseline survey data were available for 2,875 out of the 2,900 women in the study sample, although information on some characteristics is missing in cases where a woman did not respond to a particular question. In all, 1,030 women responded to the MIHOPE-Strong Start baseline survey and 1,845 responded to the MIHOPE baseline survey.

These surveys were the only source of information on the following characteristics of women at the time of study entry: race and ethnicity,² current smoking status, whether smoking was allowed in the home, use of alcohol and illicit drugs (only available for MIHOPE survey respondents), self-rated health, usual source of prenatal care (only available for MIHOPE-Strong Start survey respondents), food insecurity, depressive symptoms, anxiety symptoms, experience with physical violence and battering (among women in a relationship), whether the biological father lived in the home, and whether the mother had a spouse or partner. Additionally, baseline survey data were used in a

²Although information on maternal race and ethnicity was also provided in the vital records data, it was available for more sample members using the baseline survey data. Thus, the vital records data were not used to characterize the mother's race and ethnicity.

few instances to supplement the vital records or Medicaid data (these measures are discussed below).

Study Intake Data

As part of the study intake process and determination of eligibility for the study, home visiting program staff provided the study team with information on each woman's age and expected date of delivery. Intake data were the primary source of information on the mother's age at the time of random assignment. The expected date of delivery was used to calculate the gestational age at random assignment only in cases where the obstetric estimate of gestation was not available from vital records.

Vital Records Data

Some family baseline measures were calculated solely from the vital records data because they were not available from another source. Specifically, these include prepregnancy weight and height (which is used to determine prepregnancy body mass index, or BMI), birth parity, whether the birth was a singleton or multiple birth, and the sex of the child.

Additionally, some measures were based primarily on vital records, as these records represent the most comprehensive source of data available for particular characteristics. Specifically, information on smoking in the three months prior to pregnancy; on whether the mother was born outside of the United States; and on the mother's highest educational attainment was derived primarily from vital records and supplemented with MIHOPE family baseline survey data (the MIHOPE-Strong Start baseline survey did not include questions about these topics). Date of prenatal care initiation was derived primarily from vital records because of their accuracy and supplemented with either MIHOPE or MIHOPE-Strong Start family baseline survey data.

Appendix B provides further information on these and other measures. More information on the sample sizes for outcomes that used vital records data in the analysis are provided in the "Analysis Samples" section of this appendix.

Medicaid Enrollment Data

State Medicaid agencies provided data that was used to determine whether the mother was enrolled in Medicaid at the time of random assignment. A clear indication of enrollment in Medicaid based on administrative records was the primary source of information on the mother's Medicaid enrollment status. For women who could not be matched to Medicaid enrollment records, information on Medicaid coverage was derived

from the MIHOPE and MIHOPE-Strong Start family baseline survey questions on health insurance coverage type.

More information on sample sizes for outcomes that used Medicaid data is provided in the “Analysis Samples” section of this appendix.

Data on the Community Characteristics of Families

The residential addresses of sample members were collected at study intake. By assigning a latitude and longitude to the address (by geocoding), the community within which a sample member lived was identified. The community location was then linked to publicly available data containing information about that community. As described in Chapter 2, *community* is defined in MIHOPE-Strong Start at two levels of aggregation based on the data available. The first level is the census tract. The second level is the Primary Care Service Area (PCSA). The PCSA is a larger geographic area usually covering several zip codes, which, in turn, contain a group of adjacent census tracts. This level of aggregation reflects the fact that a health care service area typically spans the region beyond an individual’s immediate neighborhood.

Further information on data collected and sample sizes at these two levels of community boundaries is provided in the following sections.

American Community Survey Data

Census tracts were identified for 2,860 out of 2,900 families. Sociodemographic information from the U.S. Census Bureau’s 2014 American Community Survey (ACS) five-year estimates was pulled for each tract, including population size (both institutionalized and noninstitutionalized), land area, the percentage of families living in poverty, the percentage of families receiving public assistance, the unemployment rate, educational attainment among persons age 25 or older, and insurance coverage for nonelderly residents (under 65 years of age). For 40 families, the census tract was unidentifiable based on the information the study team had available. The sample sizes vary slightly by measure since certain ACS variables were not defined for all census tracts, although the majority of measures have comprehensive information.

Primary Care Service Area Data

Health care resource data for the family’s PCSA were available for 2,893 families. Seven families did not have residential addresses at baseline that could be matched to a particular PCSA. The information on health care resources, using the most recent data available at the time of the analysis, includes the following:

- Primary care physician availability was obtained from the 2010 American Medical Association master files (available through the Health Resources Services and Administration [HRSA] Data Warehouse).
- Data on Federally Qualified Health Centers (FQHCs), on FQHC look-a-likes, and on Rural Health Clinics were obtained for 2012 from the HRSA Data Warehouse.

Data on Evidence-Based Models

At the national level, both HFA and NFP provided information on their model via a survey, documents, and a series of four qualitative semistructured interviews. These data sources offered information on the intended service plan, including the intended outcomes, recipients, staffing (staff qualifications and caseload size policies), and service delivery for families. The evidence-based model developers also provided information on implementation system support tools, such as guidance on curriculum, staff development, and administrative requirements.

Data on Local Program and Home Visitor Characteristics

Staff surveys with program managers and home visitors provided information on individual staff members' demographic and work experience, the characteristics of local program policies and procedures, and the presence of various forms of support within the programs' implementation systems. The surveys also provided information about the staff's perceptions, attitudes, and beliefs regarding their work.

All 66 program managers (one from each site) completed staff surveys. For home visitors, 393 responded out of the 502 home visitors who had consented to the survey (a 78 percent response rate).

Surveys were collected at two points in time for the subsample of staff from local programs participating in MIHOPE (48 program managers and 257 home visitors): the first at study entry and the second 12 months later. If staff members responded to only one survey, the resulting information was used regardless of the timing of the survey. If staff members responded to both, the survey collected closest to the time when the local program began randomly assigning families was chosen, to more closely align the experiences of staff members with the experiences reported on the family baseline survey.

For local programs recruited for MIHOPE-Strong Start, one staff survey was conducted around six months after the random assignment of families began.

Data on Home Visiting Services Delivered to Program Group Families

Information on the home visiting services provided to program group families was derived from two data sources: (1) management information system (MIS) data provided at the levels of the program, state, and evidence-based model for families participating only in MIHOPE-Strong Start and (2) family service logs, recorded weekly by home visitors, for those participating in MIHOPE who also met the eligibility criteria for MIHOPE-Strong Start.

Management Information System Data

For 17 of the 18 local programs that were recruited for MIHOPE-Strong Start only, the service delivery information for program group families was matched to and extracted from the MIS records. Most HFA programs participating in MIHOPE-Strong Start (9 out of 11 local programs) entered data into a statewide MIS. In one state whose two local HFA programs did not have a statewide MIS, one of the programs entered data into a local-level MIS, which the study team was able to use, but the other did not, so no MIS data (concerning 16 families) were available for that local HFA program. All seven of the NFP local programs entered data into the MIS at the NFP National Service Office, which the study team was able to use.

Family Service Logs

For the families who were recruited for MIHOPE and met the eligibility criteria for MIHOPE-Strong Start, home visitors provided data on services delivered to individual families on a weekly basis. These family service logs were expected to be completed each week regardless of whether an individual home visit occurred.

Combining Data Sources

Parallel information on services delivered to families was combined across the two data sources and used in the implementation analysis. Data on dosage (the timing of home visits, the number of home visits, and the duration of participation) were consistently available across MIS sources and family service logs, as were data on most referral categories. The types of information on topics discussed during home visits varied across data sources, sometimes in ways that were not comparable. Thus, information on topics discussed was available for a smaller subset of program group families. Further detail on how the study team combined variables across data sources for referral categories and topics discussed can be found in Appendix C.

To maximize the sample size while using a standard time frame for reporting dosage, the sample was limited to families who had the potential to participate in home visiting services through the child's first birthday. Families recruited through MIHOPE whose child's first birthday occurred before July 3, 2016, and families recruited through MIHOPE-Strong Start whose child's first birthday was before January 1, 2017, met this criterion. A total of 187 families did not meet this criterion and were excluded from further analyses. Another 27 families were excluded due to miscarriage and 17 program group families were excluded because they could not be matched to MIS data.

As a result, service delivery data were available for an analytic sample of 1,341 families, covering data from November 2012 through December 2016. This includes the program group families who never received a home visit after random assignment. For each individual family who had at least one home visit, the data period for the duration of participation began with the week of the first home visit and ended with the week of the last home visit (if the last visit occurred before the child's first birthday) or the week of the last home visit that occurred near the time of the child's first birthday (if the family was still receiving home visits).

Data on Family Outcomes for the Impact Analysis

Information on family outcomes was derived from vital records and Medicaid data. These data sources are described below, followed by a discussion of the analysis samples for the outcomes based on these sources (prenatal health behaviors, birth outcomes, health care events at delivery, breastfeeding, and health care use after birth).

Vital Records

Vital records data collected include birth certificate data from the 17 states in the study and fetal death certificate data from 7 study states.³ Most of the states used the 2003 revisions of the U.S. Standard Certificate of Live Birth and U.S. Standard Report of Fetal Death. The birth certificate data contain information on the infant's health at birth, such as birth weight, gestational age, and neonatal intensive care unit (NICU) admission, which are used to measure the study's key birth outcomes. The birth certificate data also include other important information on outcomes of interest, such as the mother's smoking behavior during the third trimester; weight gain during pregnancy; timing of prenatal care initiation and overall use of prenatal care (number of prenatal care

³Two data agencies would provide only birth certificate records, not fetal death certificate data, so staff members from these two agencies did not attempt to match the study sample to their fetal death certificate data.

visits); health care events during and around the time of delivery (for example, whether the mother had a Cesarean section delivery); and personal information (such as name, date of birth, and address). Data were collected from official reports that hospitals prepare to record births.

Medicaid Data

Medicaid data are collected by the state agencies that administer Medicaid programs as part of their primary purpose of administering services. Medicaid data comprise eligibility data, which record a beneficiary's eligibility types and enrollment dates, and claims and encounter data, which record health services provided along with the associated diagnoses that justify the services. People enrolled in fee-for-service Medicaid plans have their health care use recorded in claims, whereas encounter data indicate the services received through Medicaid managed care organizations. The research team standardized the data received across the different state agencies and health care delivery or payment structures. The variation in data involves several considerations and the study performed several procedures in an effort at standardization:

- With Medicaid being a state-administered program, each Medicaid agency functions differently. Historically, states have had flexibility in the administration of Medicaid, which has resulted in varying data practices. The Balanced Budget Act of 1997 mandated a uniform process for states to submit Medicaid claims and eligibility data to the Centers for Medicare and Medicaid Services (CMS), although the collection and recording of several data elements remain distinct by state. Some elements that differ by state are the claim type and category of service as well as such things as the structure and availability of data about medical procedures for hospital inpatient events.
- Because managed care encounter data are structured differently from fee-for-service claims data in some states, the study team worked closely with each state agency to ensure that comparable data elements were provided for managed care data and to understand how to reconcile them accurately with fee-for-service data.
- The International Statistical Classification of Diseases and Related Health Problems (ICD), which is a source of diagnosis and procedure data for health care events, underwent a major revision during the time period under study (shifting from ICD-9 to ICD-10). The United States adopted the ICD-10 on October 1, 2015. The MIHOPE-Strong Start data collection period includes Medicaid data from both before and

after that date, and therefore uses both ICD-9 and ICD-10 codes. The Healthcare Effectiveness Data and Information Set (HEDIS) Quality Rating System was used to identify ICD-9 and ICD-10 codes for the same diagnoses or procedures that represented the outcomes measured.

Analysis Samples

As noted in the report, 2,911 pregnant women either enrolled in MIHOPE-Strong Start or enrolled in MIHOPE and met the MIHOPE-Strong Start eligibility criteria. Eleven women later withdrew, leaving a total sample of 2,900 women. Four women were enrolled in three small local programs that included either only program group families or only control group families. For these sites, the impacts — the differences in outcomes between randomly assigned program and control group members — could not be estimated because all sample members were randomly assigned to either the program or control group.

The sample size analyzed in Chapter 4 varies by data source and outcome measure, as described below. Appendix Table A.1 illustrates the data availability across data sources for mothers and infants in the impact analysis.

Sample for Outcomes Using Birth Certificate Data

With sample members enrolling in the study during pregnancy, in some cases, the pregnancy ended in a nonviable or nonlive birth. The team ascertained some of these cases with more certainty than others:

- Seventy-seven miscarriages or stillbirths were identified.⁴ Seventy-one of these were reported to the study team by women during follow-up through postcards that were sent to mothers about three months after the child's due date (in order to collect contact information for the baby such as name and date of birth), or through the MIHOPE 15-month follow-up survey efforts. Additionally, six miscarriages were identified in Medicaid data.

⁴Miscarriages are usually cases in which a spontaneous abortion occurs prior to 20 weeks, or at midgestation. A stillbirth is essentially the same as a fetal death and includes pregnancies that end after 20 weeks (fetal demise). However, because the study team only matched seven cases to fetal death certificate records, the term *stillbirth* is used to denote cases in which a fetal death is likely to have occurred but was never officially registered in vital records.

Appendix Table A.1

Sample Sizes and Outcome Data Availability for Mothers and Infants

Data Availability (Sample Size)	Mothers	Infants
Had potential to match to administrative records ^a	2,896	2,790
<u>Vital records</u>		
Matched to birth certificate or fetal death records ^b	2,609	2,650
<u>Medicaid records</u>		
Time period potentially covered in Medicaid data ^c		
Entire prenatal period	2,896	—
12 months after birth		
Entire 12 months	2,548	2,470
Months 1-11	266	248
No months after birth	82	72
Enrolled in Medicaid		
In prenatal period		
Entire prenatal period	1,240	—
Part of prenatal period	1,351	—
Not enrolled at all	305	—
In 12 months after birth		
Entire 12 months	1,630	1,813
Months 1-11	963	390
No months after birth	303	587

SOURCES: Calculations based on study intake data, state vital records, and Medicaid enrollment data.

NOTES: ^aThe 2,896 mothers exclude those who enrolled in the study but later withdrew (11) and those from a small site (4). The number of infants includes twins (49) but excludes known or suspected miscarriages and stillbirths (155).

^bThe 2,609 mothers include seven cases in which the mother was matched to a fetal death record. For infants, fetal death cases are not included since they were not live births. According to birth certificate data, there were 48 sets of twins (one case of twins was not indicated in the birth certificate data).

^cThese measures indicate whether the Medicaid data delivered by the state includes the specified time period in the mother's or infant's life, regardless of whether the person was actually enrolled in Medicaid during that time period. This is described as the amount of follow-up data a person potentially has.

- Seven fetal deaths were recorded on fetal death certificates (with gestational ages ranging from 15 to 34 weeks and most happening after at least 20 weeks).
- Seventy-one women did not have a vital record (either a birth certificate or a fetal death certificate), but they did have Medicaid data. In the Medicaid data for these women, there was no birth or delivery claim and no infant was affiliated with their Medicaid identification number. Thus, for purposes of the impact analysis, the study team assumed that these were nonlive births as well.

The exclusion of these 155 cases resulted in there being 2,741 women in the analysis sample. Of these women, 2,602 were matched to a birth certificate record (95 percent).⁵ In 48 of these cases, the woman gave birth to twins, resulting in the study team having birth certificate data on 2,650 infants out of 2,790 infants.⁶ The observations that were not matched may include additional cases of miscarriages, stillbirths, or fetal deaths that the study team never learned about because neither Medicaid nor the vital records data were matched to the family or the mother did not report the event during follow-up efforts.

Missing values for individual items in the vital records result in varying sample sizes for certain measures. Specifically, selected maternal outcomes were not available for sample members where the birth was recorded on the 1989 revision of the birth certificate. These outcomes include smoking in the third trimester and smoking cessation during pregnancy, breastfeeding at hospital discharge, and weight gain during pregnancy.⁷ For infants, nearly all the records have comprehensive information included in the birth certificate fields, with the number of infants with missing data on a particular item ranging from 1 to 12 (out of 2,650 infants).

Sample for Outcomes Using Medicaid Data

For the analysis of health care outcomes based on Medicaid data, 2,896 mothers and 2,790 infants (excluding cases with a known or suspected miscarriage or stillbirth) are included in the impact estimates presented in Chapter 4. For the most part, when Medicaid data were not received for sample members, the study team could not

⁵As mentioned, seven additional women were matched to a fetal death certificate (for a total of 2,609 mothers matched to vital records).

⁶Of the 49 sets of twins in the sample, 48 were matched to vital records.

⁷Sample sizes for smoking, breastfeeding, and weight gain are 2,252, 1,858, and 2,205 women, respectively.

determine whether this was because the sample members truly were not covered by Medicaid or whether they were enrolled but the study team did not receive their data. For this portion of the sample, outcome measures were coded as their not having used the service in question, on the assumption that these individuals were not enrolled in Medicaid and, therefore, did not have Medicaid-paid claims.

Certain limitations in the data cause slight underestimates of Medicaid-paid utilization in the estimates presented for both research groups, but because these limitations affect both groups equally, the impact estimates are nonetheless valid. These underestimates result from a lack of Medicaid data for some families in the analysis period. Specifically:

- **Prenatal period:** Approximately 43 percent of the 2,896 mothers in the analysis sample were enrolled in Medicaid for the entire prenatal period and 47 percent of mothers were enrolled for some portion of it (which is not surprising given that some mothers first enroll in Medicaid upon learning that they are pregnant). About 11 percent were not matched at all.
- **Year after birth:** For most families (about 88 percent), the research team could potentially collect data for the full 12 months after birth (2,548 mothers and 2,470 infants). However, only a partial year of post-birth data was potentially available for 9 percent of families (266 mothers and 248 infants), and 3 percent of babies were born too late to obtain any Medicaid data after birth (82 mothers and 72 infants). This was most often due to a state having an unusually long lag between the time a claim was paid and the time information about that claim was available for researchers to access, or to a data agency's resource limitations resulting in the study team receiving data earlier than anticipated (that is, the data were provided for the study before all sample members from the state had 12 months of follow-up data available).

Notwithstanding these exclusions, the majority of sample members were enrolled in Medicaid at least some of the time. This includes 91 percent of mothers and about 79 percent of infants. More than half of all mothers and infants were enrolled in Medicaid for the entire year after birth (1,630 mothers and 1,813 infants), although slightly fewer mothers were enrolled for the full prenatal period (about 43 percent, or 1,240 mothers). In the data collected for the study, 9 percent of mothers (264 out of 2,896) and 21 percent of babies (587 out of 2,790) were not matched to any Medicaid records (not shown).

Appendix B

**Description of Family Baseline Measures and
Supplemental Sample Characteristics Tables**

Appendix B provides information on the specific measures of family baseline characteristics in the Mother and Infant Home Visiting Program Evaluation-Strong Start (MIHOPE-Strong Start). It also includes supplemental tables for Chapter 2 of the main report, “Recruitment and Characteristics of the Sample.” The first part of this appendix describes the construction of the family baseline measures used in this study. The second part includes additional tables that are referenced in Chapter 2.

Family Baseline Measures

Gestational age at study entry. The gestational age at study entry was calculated using the obstetric estimate of gestation at delivery and the baby’s date of birth, both from vital records, in addition to the date of random assignment. If the gestational age at study entry was not available from vital records (this was the case for about 300 mothers), the study intake data were used based on the mother’s self-reported expected date of delivery and date of random assignment.

Trimester at study entry. The trimester of pregnancy was categorized based on the gestational age at study entry measure. The first trimester is the time from 1 to 13 weeks (including 13 weeks and 6 days) in the mother’s pregnancy, the second trimester is from 14 to 27 weeks (including 27 weeks and 6 days), and the third trimester is 28 weeks or more.

Maternal age. The age of the mother in years was based on her date of birth as reported at study intake (at intake, this information was used to determine whether she met the study eligibility criterion of being 15 years old or older). Baseline survey data were substituted in a handful of cases where the study intake data seemed inaccurate after comparing the date of birth from the intake record with vital records data or Medicaid data.

First-time mother. Information on the parity of the birth (that is, whether it was the first birth, second birth, or higher) was pulled from vital records. If this information was not available from vital records (this was the case for about 300 women), women enrolled in NFP programs (about 180 women) were assumed to be first-time mothers.

Maternal race and ethnicity. Race and ethnicity were based on responses to two family baseline survey questions: (1) “Are you of Hispanic, Latino, or Spanish origin?” and (2) “What is your race?”¹ Women who identified as being of Hispanic origin

¹The options were white, black or African-American, American Indian or Alaska Native, Asian Indian, Chinese, Filipino, Japanese, Korean, Vietnamese, other Asian, Native Hawaiian, Guamanian or Chamorro, Samoan, other Pacific Islander, and other race.

were asked to specify their ethnicity or place of origin (such as Mexican or Mexican-American, Cuban, Puerto Rican, or another Hispanic origin).

Mother is foreign born. This information was pulled from vital records, as the MIHOPE-Strong Start family baseline survey did not ask whether the mother was born outside of the United States. If the information was not available in the vital records data, the study team gathered this information from the Mother and Infant Home Visiting Program Evaluation (MIHOPE) family baseline survey.

Maternal education. Information on the mother's highest level of education was primarily derived from vital records, as the MIHOPE-Strong Start family baseline survey did not ask questions on education. If the information was not available in the vital records data, the study team used comparable reports from the MIHOPE family baseline survey for those participants who were part of MIHOPE. Note that women with a General Educational Development (GED) certificate were grouped with women who reported receiving a high school diploma, although some research suggests that a GED certificate does not accrue the same benefits as a high school diploma.² The information available in vital records on the highest educational attainment of study sample members did not distinguish between having a high school diploma and having a GED certificate.

Biological father present in home. Information on whether the infant's biological father resided in the home was pulled from household roster data collected in the family baseline surveys.

Health care coverage. State Medicaid enrollment data at the time of the baseline survey were used to identify women who were insured by Medicaid. For women who were not covered by Medicaid or where state Medicaid enrollment data were not available, information from family baseline surveys about insurance coverage was used. Four health care coverage categories were created: having Medicaid insurance, having private insurance, having other public insurance, and being uninsured. Other public insurance includes mothers with insurance provided by Medicare, Medigap, military health care, Indian health service, or another state-sponsored health plan.

Initiation of prenatal care in the first trimester. This information was only reported in MIHOPE-Strong Start for women who entered the study in the second or third trimester. Vital records were the primary source of information on prenatal care initiation, as they contain an exact date of the first prenatal care visit. In the absence of vital

²Tyler and Lofstrom (2010).

records, information from family baseline survey questions on the week or month that the mother received her first prenatal care visit was used.

Mother has usual source of prenatal care. The MIHOPE-Strong Start family baseline survey asked women whether they have a usual source of prenatal care. The MIHOPE family baseline survey did not include the same question.

Mother has low self-rated health. Family baseline surveys asked mothers to rank their health status, in general, as excellent, very good, good, fair, or poor. Those who reported that their health was fair or poor were considered to have low self-rated health.

Mother smoked in the three months prior to pregnancy. Information on whether the mother smoked any cigarettes in the three months prior to pregnancy is included in vital records. If the vital records were missing, the study team used information from the MIHOPE family baseline survey on smoking behavior prior to pregnancy. The same question was not included in the MIHOPE-Strong Start family baseline survey.

Mother is smoking at study entry. This measure is based on a family baseline survey question asking sample members whether they currently smoke.

Smoking is permitted in home at study entry. The family baseline surveys asked sample members whether smoking is permitted anywhere inside the home.

Mother's substance use (alcohol or illicit drugs) prior to pregnancy. Whether the mother engaged in heavy drinking, binge drinking, or illicit drug use was only asked of sample members who responded to the MIHOPE family baseline survey. There is no parallel information in the vital records. Heavy drinking is defined as the consumption of at least seven drinks per week in the three months prior to pregnancy.³ Binge drinking is considered at least four drinks on a single occasion in the three months prior to pregnancy. Drug use is defined as any illicit use of prescription drugs, marijuana, hashish, amphetamines, cocaine, heroin, tranquilizers, or hallucinogens, or sniffing gasoline, glue, hairspray, or other aerosols. The time frame of reference was the month

³This is slightly lower than the threshold of heavy drinking defined by the Centers for Disease Control and Prevention (CDC), which is eight drinks per week for women (Centers for Disease Control and Prevention, 2018). The response options to the family baseline survey question were categorical (none, less than 1, 1-3, 4-6, 7-13, 14-19, 20 or more). The team used the response category that was closest to the CDC's definition to define the heavy drinking threshold.

before pregnancy. Women who reported any of these behaviors were indicated as using substances prior to pregnancy.

Mother’s mental health concerns (depression or anxiety). Depressive symptoms were measured using a 10-item Center for Epidemiologic Studies Depression Scale (CES-D) in the family baseline surveys.⁴ A score of 8 or higher indicates clinically significant depressive symptoms. Anxiety was measured using the Generalized Anxiety Disorder 7-item scale (GAD-7),⁵ also in the family baseline surveys.⁶ A score of 10 or higher indicates moderate or severe symptoms. Women who reported elevated symptoms on either the depression or anxiety scale were categorized as exhibiting mental health concerns at baseline.

Food insecurity. Mothers were classified as having food insecurity if they indicated any experience with food not lasting or worry about food running out in the previous year. These two screening items were taken from the U.S. Department of Agriculture’s U.S. Household Food Security Survey Module and were asked in the family baseline surveys.⁷

Prepregnancy body mass index (BMI). A mother’s BMI prior to pregnancy was based on height and prepregnancy weight information from vital records. A BMI under 18.5 was classified as underweight and a BMI of 30.0 or more was considered obese; these classifications follow those defined by the World Health Organization (WHO) and the Centers for Disease Control and Prevention (CDC).⁸ Questions about prepregnancy height and weight were not asked in the family baseline surveys.

Maternal experience of physical violence or battering. Experience with physical intimate partner violence was measured using items from the Revised Conflict Tactics Scale.⁹ Mothers who responded to the MIHOPE-Strong Start family baseline survey were asked about physical violence experienced in the last three months if they had a spouse or partner in the past three months or at the time of the interview. Mothers who responded to the MIHOPE family baseline survey were asked about physical violence experienced in the last year only if they had a spouse or partner at the time of the interview.

⁴Kohout, Berkman, Evans, and Cornoni-Huntley (1993).

⁵Copyright © (2019) American Medical Association.

⁶Spitzer, Kroenke, Williams, and Löwe (2006).

⁷U.S. Department of Agriculture, Economic Research Service (2017).

⁸Centers for Disease Control and Prevention (2017a); World Health Organization (2018).

⁹Straus, Hamby, Boney-McCoy, and Sugarman (1996).

Experience with battering was measured using a six-item version of the Women's Experience with Battering scale,¹⁰ modified with the permission of Professor Paige Smith at the University of North Carolina at Greensboro. Mothers who indicated in the family baseline surveys that they had a spouse or partner at the time of the interview were asked about experience with battering.

Community Characteristics

Sociodemographic Characteristics

The sociodemographic characteristics of communities were derived from the families' census tracts based on where they resided at time of study intake. The census tract data are from the U.S. Census Bureau's 2014 American Community Survey (ACS) five-year estimates.

Total population size. Total population is the total number of institutionalized and noninstitutionalized persons residing in the tract.

Population density. Population density for the census tract was calculated as the total population size per square land mile. Higher numbers reflect greater density (more persons per land area).

Neighborhood socioeconomic disadvantage index. The neighborhood socioeconomic index score is a composite of four different indicators from the ACS for census tracts: (1) the percentage of families living in poverty; (2) the percentage of families receiving public assistance (either Supplemental Security Income or cash assistance); (3) the percentage of persons age 16 and older in the civilian labor force who are unemployed; and (4) the percentage of persons age 25 and older without a high school degree or equivalency.¹¹

Each indicator was standardized by subtracting the mean at the national level and dividing by the standard deviation for that measure. These standardized values were summed to form an index score. The index was then normed with a mean of zero and standard deviation of one to the population-weighted national averages.

¹⁰Smith, Earp, and DeVellis (1995).

¹¹Turney and Harknett (2010).

Uninsurance rates. The rates were calculated from ACS variables and reflect the percentage of people among the nonelderly population (under 65 years old) in the census tract who reported not having insurance coverage.

Health Care Resources

The health care resource information reflects the availability of physicians and facilities in the Primary Care Service Area (PCSA) where sample members resided at study intake.

Primary care physician supply. Primary care physicians are clinically active and include family practice physicians, internal medicine physicians, obstetricians and gynecologists, and pediatricians located within the PCSA. A higher number of primary care physicians per 10,000 persons (based on the 2010 U.S. Census) indicates greater supply. Low primary care physician supply is defined as having less than or equal to one doctor per 3,500 persons (using 2010 U.S. Census population numbers), which is the traditional calculation for a Health Professional Shortage Area index.¹²

Health care facility supply. Measures of health care facility supply were based on the number of grant-funded Federally Qualified Health Centers (FQHCs), Rural Health Clinics (RHCs), and grant-funded FQHC look-alikes located within the PCSA.¹³ The number of FQHC sites (including FQHCs, FQHC look-alikes, and RHCs) per square mile of land area and population size (according to the 2010 U.S. Census) indicates the density of such facilities.

¹²Grumbach, Vranizan, and Bindman (1997).

¹³An FQHC look-alike is an organization that meets all of the eligibility requirements of an organization that receives FQHC funding through the HRSA Health Center Program but does not receive Health Center funding.

Appendix Table B.1

Characteristics of Local Programs at Study Entry

Characteristic (%)	Overall	HFA	NFP
<u>Type of local implementing agency</u>			
Community-based nonprofit	56.1	78.4	27.6
Local health department	27.3	8.1	51.7
Health care organization	12.1	8.1	17.2
Other ^a	4.5	5.4	3.4
<u>Type of county served^b</u>			
Metropolitan	81.8	78.4	86.2
Nonmetropolitan	10.6	13.5	6.9
Both	7.6	8.1	6.9
<u>Years program had been in operation at study entry^c</u>			
2 to 3	1.5	2.7	0.0
4 to 5	10.6	2.7	20.7
6 or more	87.9	94.6	79.3
<u>Enrollment capacity^d</u>			
50 families or fewer	4.5	8.1	0.0
51-100 families	27.3	40.5	10.3
More than 100 families	68.2	51.4	89.7
<u>Proportion of funding from the MIECHV program^e</u>			
None	12.7	14.3	10.7
Less than 20%	30.2	25.7	35.7
20% to 49%	30.2	40.0	17.9
50% to 74%	12.7	11.4	14.3
75% or more	14.3	8.6	21.4
Sample size	66	37	29

SOURCES: Calculations based on data from the MIHOPE program manager baseline survey, the MIHOPE-Strong Start program manager survey, and the MIHOPE and MIHOPE-Strong Start site-selection teams.

NOTES: HFA = Healthy Families America, NFP = Nurse-Family Partnership, MIECHV = Maternal, Infant, and Early Childhood Home Visiting.

Percentages may not sum to 100 because of rounding.

^aOther types of organizations include various types of social-service nonprofits, such as Goodwill Industries and Healthy Families.

^bTo designate counties as metropolitan or nonmetropolitan, this report follows the U.S. Department of Agriculture Economic Research Service's Rural-Urban Continuum Codes classification scheme (U.S. Department of Agriculture, Economic Research Service, 2013).

^cPrograms were asked to report the number of years they had operated the specific evidence-based model.

^dEnrollment capacity is the number of families that can be served at any one time.

^ePercentages are based on responses from 63 program managers. Two of the three program managers who were missing information on this question were recruited through MIHOPE and so received at least some MIECHV funding, but the proportion is unknown.

Appendix Table B.2

Selected Family Characteristics at Baseline, by Evidence-Based Model

Characteristic	Overall	HFA	NFP	Sample Size of Measure
<u>Maternal sociodemographic</u>				
Average gestational age ^a (weeks)	16.8	19.9	15.1	2,900
Pregnancy stage (%)				2,900
First trimester	37.1	24.6	44.0	
Second trimester	54.6	55.0	54.3	
Third trimester	8.3	20.4	1.7	
Age of mother				
Average age ^b (years)	22.3	23.8	21.4	2,900
Age 15-20 (%)	47.1	37.4	52.5	2,900
First-time mother (%)	84.0	52.7	99.1	2,776
Race/ethnicity (%)				2,868
Mexican or Mexican-American	25.3	18.2	29.3	
Other Hispanic	17.5	14.7	19.1	
Non-Hispanic white	21.1	30.2	16.1	
Non-Hispanic black	26.6	27.7	26.0	
Other/multiracial	9.5	9.2	9.6	
Foreign-born (%)	22.3	18.9	24.1	2,728
Highest level of education (%)				2,754
Less than high school diploma or General Educational Development (GED) certificate	34.1	36.3	32.9	
Under 21 years	22.7	17.9	25.4	
21 years or older	11.4	18.3	7.5	
High school diploma or GED	37.9	37.9	37.9	
More than high school diploma or GED	28.0	25.8	29.2	
Biological father lives in the home (%)	37.2	38.4	36.6	2,783
<u>Health care coverage and use and health status (%)</u>				
Insurance coverage of mother				2,818
Medicaid/Children's Health Insurance Program (CHIP)	86.3	87.7	85.6	
Private	4.0	3.7	4.1	
Uninsured	8.1	7.3	8.5	
Other public insurance	1.6	1.3	1.8	

(continued)

Appendix Table B.2 Baseline Characteristics (continued)

Characteristic	Overall	HFA	NFP	Sample Size of Measure
Initiated prenatal care in first trimester (among those who enrolled in study in second or third trimester)	71.2	70.8	71.5	1,803
Has usual source of prenatal care	82.8	88.3	79.3	1,030
Maternal health self-rated "poor" or "fair"	10.5	12.3	9.5	2,872
<u>Risk factors (%)</u>				
Tobacco use				
Any smoking in 3 months prior to pregnancy	16.9	23.7	13.2	2,758
Any current smoking	9.2	15.9	5.6	2,858
Smoking is permitted in the home	18.8	24.1	15.9	2,855
Substance use (alcohol or drugs) prior to pregnancy				
Any heavy drinking	2.9	3.5	2.6	1,827
Any binge drinking	23.8	24.3	23.5	1,829
Any use of illicit drugs	15.3	13.8	16.1	1,833
Maternal mental health concerns (depression or anxiety)				
Depressive symptoms	37.8	39.6	36.8	2,860
Anxiety symptoms	22.7	23.3	22.4	2,858
Food insecurity	53.2	60.1	49.4	2,856
Prepregnancy body mass index (BMI)				
Underweight	5.8	5.6	6.0	2,227
Obese	29.8	34.3	27.1	2,227
Maternal experience of physical violence or psychological battering among women in a relationship				
Any physical violence toward mother ^c	8.5	10.1	7.6	2,248
Experience with battering	7.7	8.6	7.2	2,117
Sample size	2,900	1,028	1,872	

SOURCES: Calculations based on study intake data, data from the MIHOPE and MIHOPE-Strong Start family baseline surveys, state vital records data, and Medicaid enrollment data.

NOTES: HFA = Healthy Families America, NFP = Nurse-Family Partnership.

For detailed descriptions of measures, see "Family Baseline Measures" section in Appendix B.

^aStandard deviations: overall = 6.9; HFA = 7.5; NFP = 5.9.

^bStandard deviations: overall = 5.3; HFA = 5.9; NFP = 4.8.

^cFor MIHOPE respondents, the period referenced is the previous year. For MIHOPE-Strong Start families, the period is the prior three months.

Appendix Table B.3

Selected Family Characteristics at Baseline for Program Group Families, by Evidence-Based Model

Characteristic	Overall	HFA	NFP	Sample Size of Measure
<u>Maternal sociodemographic</u>				
Average gestational age ^a (weeks)	16.8	19.7	15.1	1,572
Pregnancy stage (%)				1,572
First trimester	38.0	26.5	44.6	
Second trimester	53.4	53.3	53.5	
Third trimester	8.5	20.2	1.9	
Age of mother				
Average age ^b (years)	22.2	23.6	21.4	1,572
Age 15-20 (%)	47.0	37.4	52.4	1,572
First-time mother (%)	84.0	53.2	99.2	1,499
Race/ethnicity (%)				1,553
Mexican or Mexican-American	25.6	17.9	29.9	
Other Hispanic	17.9	14.8	19.6	
Non-Hispanic white	19.6	27.9	14.9	
Non-Hispanic black	28.2	30.4	27.0	
Other/multiracial	8.8	8.9	8.7	
Foreign-born (%)	22.5	18.4	24.8	1,465
Highest level of education (%)				1,482
Less than high school diploma or General Educational Development (GED) certificate	34.5	38.3	32.3	
Under 21 years	22.5	19.3	24.3	
21 years or older	12.0	19.0	8.1	
High school diploma or GED	36.9	36.2	37.3	
More than high school diploma or GED	28.6	25.5	30.4	
Biological father lives in the home (%)	37.4	38.3	36.8	1,504
<u>Health care coverage and use and health status (%)</u>				
Insurance coverage of mother				1,530
Medicaid/Children's Health Insurance Program (CHIP)	86.7	88.9	85.5	
Private	4.1	3.6	4.4	
Uninsured	7.3	6.0	8.1	
Other public insurance	1.8	1.5	2.0	

(continued)

Appendix Table B.3 Baseline Characteristics for Program Families (continued)

Characteristic	Overall	HFA	NFP	Sample Size of Measure
Initiated prenatal care in first trimester (among those who enrolled in study in second or third trimester)	73.3	74.4	72.4	962
Has usual source of prenatal care	82.9	89.2	78.9	624
Maternal health self-rated "poor" or "fair"	10.5	12.5	9.4	1,555
<u>Risk factors (%)</u>				
Tobacco use				
Any smoking in 3 months prior to pregnancy	16.7	23.0	13.2	1,487
Any current smoking	9.0	14.6	5.9	1,545
Smoking is permitted in the home	18.7	22.7	16.5	1,542
Substance use (alcohol or drugs) prior to pregnancy				
Any heavy drinking	2.8	3.8	2.3	921
Any binge drinking	23.8	24.8	23.3	921
Any use of illicit drugs	15.0	12.7	16.1	923
Maternal mental health concerns (depression or anxiety)				
Depressive symptoms	36.0	39.0	34.2	1,546
Anxiety symptoms	21.3	22.1	20.8	1,546
Food insecurity	52.6	58.2	49.4	1,547
Prepregnancy body mass index (BMI)				
Underweight	6.6	6.1	6.9	1,216
Obese	31.2	34.2	29.3	1,216
Maternal experience of physical violence or psychological battering among women in a relationship				
Any physical violence toward mother ^c	8.5	10.4	7.5	1,236
Experience with battering	9.0	9.9	8.6	1,164
Sample size	1,572	569	1,003	

SOURCES: Calculations based on study intake data, data from the MIHOPE and MIHOPE-Strong Start family baseline surveys, state vital records data, and Medicaid enrollment data.

NOTES: HFA = Healthy Families America, NFP = Nurse-Family Partnership.

For detailed descriptions of measures, see "Family Baseline Measures" section in Appendix B.

^aStandard deviations: overall = 6.9; HFA = 7.5; NFP = 6.0.

^bStandard deviations: overall = 5.2; HFA = 5.9; NFP = 4.6.

^cFor MIHOPE respondents, the period referenced is the previous year. For MIHOPE-Strong Start families, the period is the prior three months.

Appendix C

Supplemental Materials for the Implementation Analysis

Appendix C provides additional detail on some of the implementation measures used in the Mother and Infant Home Visiting Program Evaluation-Strong Start (MIHOPE-Strong Start). Specifically, the study team describes measures that were created to capture the content of services delivered to program group families, such as referrals and topics discussed, and provides further detail on the multivariate analysis of service delivery patterns presented in Chapter 3, “Implementation of Home Visiting Services.”

As described in the chapter and in Appendix A, Chapter 3 draws from several different data sources to understand how programs were implemented; which home visiting services were delivered; and which family, home visitor, and local program characteristics are related to explaining the differences in services that families received. These data sources include:

- family baseline information on program group families, including information on families’ community characteristics
- staff surveys of local programs and home visitors
- surveys and interviews with the two evidence-based model developers in the study — Healthy Families America (HFA) and Nurse-Family Partnership (NFP)
- service delivery information collected from family service logs in the Mother and Infant Home Visiting Program Evaluation (MIHOPE) and management information system (MIS) data collected in MIHOPE-Strong Start.

The first section of this appendix discusses how information on home visiting content, described in Chapter 3, was combined across different MIS data sources for the sample of families recruited through MIHOPE-Strong Start and the family service logs collected for the sample of families in MIHOPE who also met the eligibility criteria for MIHOPE-Strong Start.

The appendix also provides further detail on the approach used to examine service delivery variation across family, home visitor, and local program characteristics. Finally, it includes a discussion of the analysis sample and summarizes results from additional explorations of variation in the services received among program group families.

All tables are grouped for convenience at the end of the appendix. Appendix Tables C.3 through C.14 were referenced in Chapter 3 and are not discussed further here.

Mapping Home Visiting Content Measures Across Data Sources

The home visiting content information in MIHOPE-Strong Start includes topics discussed during home visits and categories about the types of referrals made. Unlike dosage, the recording of information on referrals and topics discussed in home visits varied across the service delivery data sources available in the study. The content categories examined in the implementation analysis combined similar information found across data sources, but the availability and definitions of content categories could vary across individual items and by data source. These data sources include:

- The MIHOPE family service logs
- The MIS at the NFP National Service Office
- The MISs at four state-specific or local-level HFA programs

Appendix Tables C.1 and C.2 document how the study team mapped information across these data files to create service delivery measures for (1) referral categories and (2) topics discussed in home visits. The terms used in these tables reflect the language included in each data source. Therefore, there are slight differences in some wording (for example, between “lactation support” and “breastfeeding support”).

Approach to Explaining the Variation in Services Delivered

In Chapter 3, findings are presented based on analyses that examine the relationships between a set of family, home visitor, and local program characteristics and two measures of dosage: (1) the number of home visits a family received during pregnancy and (2) the duration of a family’s participation (in months) during pregnancy. The purpose of this type of analysis is to examine the unique (independent) association between a particular characteristic and a service delivery measure while adjusting for differences in other sample characteristics. This section of the appendix expands on that analysis, showing results for two additional service delivery measures.

As designed, the implementation analysis is multilevel in nature, with different families in the sample served by the same home visitor and a group of home visitors working within the same local program. Using a multivariate, multilevel regression approach, characteristics at one level (differences across families, for example) and across levels (such as the family and the home visitor) can be simultaneously examined.

Of interest in the implementation analysis for MIHOPE-Strong Start is understanding the variation observed in the data across several key service delivery measures during the pregnancy period. Specifically:

- What factors (for example, family, home visitor, and local program characteristics) explain which program group families engage in any amount of home visiting during pregnancy?
- Among program group families who engaged in at least one visit: (1) What factors appear to be most salient in explaining which families receive more home visits or participate for longer periods of time before birth? (2) What factors are important in explaining whether a family receives referrals for prenatal health (including maternal physical health)¹ during pregnancy?

Service Delivery Measures During Pregnancy

Four dependent variables (that is, four different measures of service delivery) were examined, all of which focus on the service delivery period up until the infant's birth:

- Whether a program group family ever received a home visit
- The number of home visits received (frequency) among those who received at least one visit²
- Months of participation (duration) for those families who received at least one visit³
- Receipt of referrals for prenatal health (including maternal physical health) among those who received at least one visit

The family, home visitor, and local program characteristics of interest as explanatory variables (covariates) are described in Chapter 3.

Multilevel Models

For the dependent variable of ever having received a home visit, a two-level model was estimated (families are only nested within local programs, as no home visitor data are available for families who never received a home visit). For the dependent variables of number of home visits, duration, and referral receipt among those with at least

¹Referrals for prenatal health and for maternal physical health were two separate categories in the service delivery data. However, because a referral for maternal physical health would likely be related to or could influence the health of the pregnancy, the multivariate analysis included referrals for either prenatal health or maternal physical health under the umbrella of "referrals for prenatal health."

²Results of this analysis are discussed in Chapter 3.

³Results of this analysis are discussed in Chapter 3.

one home visit, three-level models were estimated. The three-level modeling approach is described below.

First, an “empty” model was estimated for each service delivery dependent variable. The empty model has no covariates at any level. This step provided information about how much variation in service delivery occurred across families, across home visitors, and across local programs. The nesting of families who were served by home visitors from local programs was reflected in the multilevel analyses of service delivery in the following general way:

$$\begin{aligned} \text{Level 1 (family):} & \quad Y_{ijk} = \pi_{0jk} + e_{ijk} \\ \text{Level 2 (home visitors):} & \quad \pi_{0jk} = \beta_{00k} + r_{0jk} \\ \text{Level 3 (local programs):} & \quad \beta_{00k} = \gamma_{000} + u_{00k} \end{aligned}$$

where:

$$\begin{aligned} Y_{ijk} &= \text{service delivery measure } Y \text{ for family } i \text{ served by home visitor } j \text{ in local program } k; \\ \pi_{0jk} &= \text{the mean service delivery for home visitor } j \text{ in local program } k; \\ e_{ijk} &= \text{individual-level random error around the home visitor mean service delivery; assumed to be normally distributed with a mean of 0 and variance of } \sigma^2. \\ \beta_{00k} &= \text{the mean service delivery for local program } k; \\ r_{0jk} &= \text{home visitor-level random error around the local program mean service delivery. For a linear model, this is assumed to be normally distributed with a mean of 0 and variance of } \tau_\pi^2. \\ \gamma_{000} &= \text{the grand mean of service delivery measure } Y; \text{ and} \\ u_{00k} &= \text{local program-level random error around the grand mean. For a linear model, this is assumed to be normally distributed with a mean of 0 and variance of } \tau_\beta^2. \end{aligned}$$

Second, all prespecified covariates at the family, home visitor, and local program levels were entered into the model as follows:

$$\begin{aligned} \text{Level 1 (family):} & \quad Y_{ijk} = \pi_{0jk} + \sum_{f=1}^F FC_{fijk} + e_{ijk} \\ \text{Level 2 (home visitors):} & \quad \pi_{0jk} = \beta_{00k} + \sum_{h=1}^H HVC_{hjk} + r_{0jk} \\ \text{Level 3 (local programs):} & \quad \beta_{00k} = \gamma_{000} + \sum_{l=1}^L LPC_{lk} + u_{00k} \end{aligned}$$

where:

$$FC_{fijk} = \text{family characteristic } f \text{ for family } i \text{ served by home visitor } j \text{ in local program } k;$$

HVC_{hjk} = home visitor characteristic h for home visitor j in local program k ;
 LPC_{lk} = local program characteristic l for local program k .

Note that a linear model was used for all of the dependent variables, even for the binary dependent variables (whether the family ever received a home visit and whether a referral for prenatal health was ever provided). Models were estimated in Stata 14.0, using Stata's *mixed* commands. The linear model for binary outcomes produces coefficient estimates that are straightforward to interpret and that are similar to those produced by logit models when evaluated near the center of the distribution. To run sensitivity checks, logit models were also examined for the two binary dependent variables, using Stata's *melogit* commands. The conclusions are very similar to the linear approach (results not shown).

Analysis Samples

The analyses of service delivery used information on program group families only. The various analyses relied on different sample sizes, depending on the variables examined and on data availability. Complete case analysis was used — that is, only observations without any missing data for any of the measures in the model were included in the analysis. Of note for the dosage (number of home visits and duration of participation) and referral analysis sample is that this strategy ended up causing several hundred families to be excluded from the analysis because not all home visitors who served families in the sample completed a staff survey. For the sample of families who received at least one home visit and met the inclusion criteria for the service delivery analysis described in Chapter 3 (1,154 women),⁴ 261 did not have home visitor data associated with them.

Because sample members with missing data can be different from those who do not have any data missing, checks were done to see whether there were patterns in which families were included or excluded across the set of characteristics examined. One set of checks compared the sample characteristics of the families and local programs included in the analysis sample for the ever-visited models to the characteristics of families and local programs who were excluded from these models. Another set compared the sample characteristics of the families, home visitors, and local programs

⁴As noted in Chapter 3, the presentation of results on the services delivered to program group families was restricted to families who had the potential to participate in home visiting services through the child's first birthday, who had not had miscarriages, and who did not have missing data on service delivery measures.

included in the analysis sample for the dosage and referral models to the characteristics of families, home visitors, and local programs excluded from these models.

Results of these checks are shown in Appendix Table C.15. Across most characteristics, there is little difference between the sample members who were included in the analyses and those who were excluded. For the ever-received-a-home-visit analysis, families who were excluded from the models because of missing data were more likely than those included in the models to be mothers with less than a high school diploma or a General Educational Development (GED) certificate. For the analyses of service delivery (number of home visits, duration, and referrals) among families who received at least one home visit, families who were excluded due to missing data received their first home visit over one week later than the average family included in the analyses. The excluded families were also less likely to be of non-Hispanic white or non-Hispanic black race and were more likely to be of other Hispanic ethnicity. Finally, the excluded families were less likely to be in a local program with dedicated staff for continuous quality improvement.

Appendix Tables C.16 through C.19 show the results from the multivariate multilevel models. Results of two models explaining variation in the dosage of home visiting during pregnancy are discussed in Chapter 3 and shown in Figures 3.4 and 3.5: Appendix Table C.16 presents full results from the models examining variation in the number of home visits received during pregnancy, depicted in Figure 3.4; Appendix Table C.17 presents full results from the models examining variation in the duration of participation during pregnancy (number of months), depicted in Figure 3.5.

This appendix also presents results for two additional analyses not shown or discussed in Chapter 3: (1) whether the family ever received a home visit during pregnancy (see Appendix Table C.18) and (2) whether the family ever received a referral for prenatal health (including maternal physical health) during pregnancy (see Appendix Table C.19).

Each of the following tables presents two types of estimates of the relationship between service delivery and the characteristics of families, home visitors, and local programs. The bivariate associations, sometimes called unadjusted associations, do not take other characteristics into account when examining how a particular characteristic is related to service delivery. The adjusted associations consider the role of the other characteristics shown in the tables, and thus show the independent association between a particular characteristic and the service delivery measure.

A summary of the results from the two analyses of service delivery not discussed in Chapter 3 follows:

Ever received a home visit during pregnancy. This analysis examined how family and local program characteristics are associated with whether a family received at least one home visit during pregnancy (Appendix Table C.18).⁵ Results show that the likelihood of receiving at least one home visit during pregnancy was similar across different types of families and local programs. Notably, women who enrolled earlier in their pregnancies were no more likely to receive a home visit than those who enrolled later, even though women who enrolled earlier had more opportunity to receive a visit. This is probably because the first home visit generally occurred soon after enrollment, as described in the “Service Delivery” section of Chapter 3.

Receipt of referral for prenatal health (including maternal physical health) during pregnancy. As noted in Chapter 3, and shown in Table 3.7, among families who received at least one home visit, the most common type of referral during pregnancy was for prenatal health (42 percent of families). A smaller percentage of families also received referrals for maternal health concerns that were likely independent of pregnancy (these could include referrals for health conditions that were apparent before and not specific to pregnancy) (15 percent). As noted earlier, the last set of analyses examining variation in service delivery combined referrals for prenatal health and maternal physical health (46 percent), given that both are likely important for supporting a healthy birth.

Across the characteristics examined, a handful have an independent association with the likelihood of receiving a referral for prenatal health or maternal physical health (Appendix Table C.19). First, mothers who received the first home visit later in pregnancy were less likely to receive a referral for prenatal health or maternal physical health than mothers who began services earlier, which could reflect greater opportunity (time) for home visitors to detect issues related to prenatal or maternal physical health. Second, mothers in fair or poor health at study entry were 12 percent more likely to receive a referral for prenatal health or maternal physical health than mothers who reported they were in better health. Only one of the home visitor or local program characteristics is associated with the likelihood of receiving referrals in the fully adjusted models: When home visitors had more years of experience, mothers were slightly less likely to receive a referral for prenatal or maternal physical health.

Finally, Appendix Table C.20 presents the proportion of variance for selected service delivery measures that is explained by family characteristics, home visitor characteristics, and local program characteristics. As shown, much of the variance for each

⁵For this analysis, no home visitor data was used since families who never received a home visit were not connected to a home visitor.

measure of service delivery is a result of differences across the families, particularly whether a family ever received a home visit. For the dosage measures and the referral measure, anywhere from 74 percent to 83 percent of the variance results from differences in families. A smaller percentage — from 4 percent to 12 percent — results from differences in home visitors, and anywhere from 9 percent to 13 percent of the variance is due to differences at the local program level.

Appendix Table C.1

Mapping of Referral Categories Across Service Delivery Data Sources

MIHOPE-Strong Start Category	MIHOPE Family Service Log	NFP National Service Office MIS	State 1 HFA MIS	State 2 HFA MIS	State 3 HFA MIS	State 4 HFA MIS	
Prenatal health	<ul style="list-style-type: none"> • Prenatal care <ul style="list-style-type: none"> ○ Nutrition ○ Abstinence from tobacco, alcohol, drugs ○ OB/GYN care 	<ul style="list-style-type: none"> • Prenatal care 	<ul style="list-style-type: none"> • Prenatal care 	<ul style="list-style-type: none"> • Prenatal care 	<ul style="list-style-type: none"> • Prenatal care 	<ul style="list-style-type: none"> • Prenatal care 	
	<ul style="list-style-type: none"> • Childbirth education 	<ul style="list-style-type: none"> • Childbirth education 	<ul style="list-style-type: none"> • Prenatal/childbirth education 	<ul style="list-style-type: none"> • Childbirth education 	<ul style="list-style-type: none"> • Childbirth education 	<ul style="list-style-type: none"> • Childbirth education 	<ul style="list-style-type: none"> • Childbirth education
Maternal health (outside of pregnancy)	<ul style="list-style-type: none"> • Maternal preventive care <ul style="list-style-type: none"> ○ Well-woman visits ○ Postpartum check-up ○ Dental care ○ Immunizations 	<ul style="list-style-type: none"> • Adult primary care (well-woman) • Adult primary care (sick care) • Dental care • Postpartum care 	<ul style="list-style-type: none"> • Adult primary care 	<ul style="list-style-type: none"> • Adult primary care • Dental care • Postpartum care • Immunizations 	<ul style="list-style-type: none"> • Adult primary care • Dental care • Postpartum care • Immunizations 	<ul style="list-style-type: none"> • Adult primary care • Dental care • Postpartum care • Immunizations 	<ul style="list-style-type: none"> • Adult primary care • Dental care • Postpartum care • Immunizations
Family planning	<ul style="list-style-type: none"> • Family planning and reproductive health care <ul style="list-style-type: none"> ○ Contraception ○ Birth spacing ○ Sexual health ○ HIV/STD testing ○ Adoption 	<ul style="list-style-type: none"> • Adoption 	<ul style="list-style-type: none"> • Family planning 	<ul style="list-style-type: none"> • Family planning • HIV and STD testing • Pregnancy testing 	<ul style="list-style-type: none"> • Family planning • HIV and STD testing • Pregnancy testing 	<ul style="list-style-type: none"> • Family planning • HIV and STD testing • Pregnancy testing 	<ul style="list-style-type: none"> • Family planning • HIV and STD testing
Tobacco and substance use	<ul style="list-style-type: none"> • Substance use treatment (alcohol and other drugs) • Smoking cessation 	<ul style="list-style-type: none"> • Drug and alcohol use services • Smoking cessation 	<ul style="list-style-type: none"> • Substance use services • Smoking cessation 	<ul style="list-style-type: none"> • Substance use services • Smoking cessation 	<ul style="list-style-type: none"> • Substance use services • Smoking cessation 	<ul style="list-style-type: none"> • Substance use services • Smoking cessation 	<ul style="list-style-type: none"> • Drug and alcohol education or treatment

(continued)

Appendix Table C.1 Mapping of Referral Categories Across Service Delivery Data Sources (continued)

MIHOPE-Strong Start Category	MIHOPE Family Service Log	NFP National Service Office MIS	State 1 HFA MIS	State 2 HFA MIS	State 3 HFA MIS	State 4 HFA MIS
Mental health and stress	<ul style="list-style-type: none"> • Mental health treatment <ul style="list-style-type: none"> ○ Counseling/psychotherapy ○ Relationship counseling ○ Grief/loss/bereavement 	<ul style="list-style-type: none"> • Mental health treatment or therapy • Relationship counseling 	<ul style="list-style-type: none"> • Mental health counseling • Bereavement counseling and support • Moving Beyond Depression class 	<ul style="list-style-type: none"> • Mental health treatment • Mental health counseling 	<ul style="list-style-type: none"> • Mental health treatment • Mental health counseling 	<ul style="list-style-type: none"> • Mental health treatment • Mental health counseling
Intimate partner violence (IPV)	<ul style="list-style-type: none"> • IPV shelter • IPV counseling/anger management 	<ul style="list-style-type: none"> • IPV services 	<ul style="list-style-type: none"> • Family violence/abuse service 	<ul style="list-style-type: none"> • IPV services 	<ul style="list-style-type: none"> • IPV services 	<ul style="list-style-type: none"> • IPV services • IPV counseling
Breastfeeding, infant feeding, and nutrition	<ul style="list-style-type: none"> • Breastfeeding, infant feeding, and nutrition <ul style="list-style-type: none"> ○ Breastfeeding class ○ Lactation consultation ○ Food prep ○ Breast pump ○ Nutritionist or dietician 	<ul style="list-style-type: none"> • Lactation support 	<ul style="list-style-type: none"> • Nutritional counseling 	<ul style="list-style-type: none"> • Breastfeeding support • Nutritional counseling 	<ul style="list-style-type: none"> • Breastfeeding support • Nutritional counseling 	<ul style="list-style-type: none"> • Lactation consultant • Nutritional counseling
Child health and safety	<ul style="list-style-type: none"> • Pediatric primary care <ul style="list-style-type: none"> ○ Well-child visits ○ Immunizations ○ Dental care • Car-seat safety • Lead safety/ screen • Poison control • Smoke alarm 	<ul style="list-style-type: none"> • Primary care – well-child visits • Primary care – sick-child visits • Dental care • Injury prevention <ul style="list-style-type: none"> ○ Car seat ○ Smoke alarm 	<ul style="list-style-type: none"> • Child primary care 	<ul style="list-style-type: none"> • Child primary care • Dental care • Immunizations 	<ul style="list-style-type: none"> • Child primary care • Dental care • Immunizations 	<ul style="list-style-type: none"> • Child primary care • Immunizations

(continued)

Appendix Table C.1 Mapping of Referral Categories Across Service Delivery Data Sources (continued)

MIHOPE-Strong Start Category	MIHOPE Family Service Log	NFP National Service Office MIS	State 1 HFA MIS	State 2 HFA MIS	State 3 HFA MIS	State 4 HFA MIS
Public assistance (includes health insurance)	<ul style="list-style-type: none"> • Public assistance <ul style="list-style-type: none"> ○ SNAP ○ WIC ○ TANF ○ Medicaid ○ SCHIP 	<ul style="list-style-type: none"> • WIC • TANF • Food stamps • SSI • Medicaid • SCHIP • Private insurance • Military insurance 	<ul style="list-style-type: none"> • WIC • TANF • Food stamps • SSI • Health insurance 	<ul style="list-style-type: none"> • WIC • TANF • Food stamps • SSI • Medicaid • Family/Child Health Plus (SCHIP) 	<ul style="list-style-type: none"> • WIC • TANF • Food stamps • SSI • Medicaid • Family/Child Health Plus (SCHIP) 	<ul style="list-style-type: none"> • WIC • TANF • Food stamps • SSI • Medicaid
Housing	<ul style="list-style-type: none"> • Housing <ul style="list-style-type: none"> ○ Utility assistance ○ Emergency shelter/housing ○ Section 8 	<ul style="list-style-type: none"> • Housing 	<ul style="list-style-type: none"> • Housing/shelter • Energy assistance 	<ul style="list-style-type: none"> • Housing assistance/emergency shelter • Energy assistance 	<ul style="list-style-type: none"> • Housing assistance/emergency shelter • Energy assistance 	<ul style="list-style-type: none"> • Permanent housing • Shared housing • Transitional housing • Energy assistance • Section 8 voucher
Other	<ul style="list-style-type: none"> • Other • Job training • Concrete goods • Child care • Adult education 	<ul style="list-style-type: none"> • Other • Job training • Concrete goods • Child care • Adult education 	<ul style="list-style-type: none"> • Other • Job training • Concrete goods • Child care • Adult education 	<ul style="list-style-type: none"> • Other • Job training • Concrete goods • Child care • Adult education 	<ul style="list-style-type: none"> • Other • Job training • Concrete goods • Child care • Adult education 	<ul style="list-style-type: none"> • Other • Job training • Concrete goods • Child care • Adult education

SOURCES: MIHOPE family service logs, Nurse-Family Partnership (NFP) national service management information system (MIS) data, and state-specific and local-level Healthy Families America (HFA) MIS data.

NOTES: HIV = human immunodeficiency virus; OB/GYN = obstetrics and gynecology; SCHIP = State Children’s Health Insurance Program; SNAP = Supplemental Nutrition Assistance Program; SSI = Supplemental Security Income; STD = sexually transmitted disease; TANF = Temporary Assistance for Needy Families; WIC = Women, Infants, and Children program. Referral categories using NFP MIS data capture only referrals for the mother and index child, while those coming from HFA MIS data vary by state and may include information for other “family members” as defined by the individual state.

Appendix Table C.2

Mapping of Topic Categories Across Service Delivery Data Sources

MIHOPE-Strong Start Category	MIHOPE Family Service Log	NFP National Service Office MIS	State 1 HFA MIS	State 2 HFA MIS	State 3 HFA MIS	State 4 HFA MIS
Prenatal health	<ul style="list-style-type: none"> • Prenatal health behaviors/prenatal care <ul style="list-style-type: none"> ○ Nutrition ○ Abstinence from tobacco, alcohol, drugs ○ OB care 		<ul style="list-style-type: none"> • Prenatal education • Childbirth education • Labor and delivery 	<ul style="list-style-type: none"> • Prenatal care and nutrition • Prematurity • Harmful substances 	<ul style="list-style-type: none"> • Prenatal care and pregnancy 	
	<ul style="list-style-type: none"> • Child health (during pregnancy) <ul style="list-style-type: none"> ○ Health status and health care use ○ Regular check-ups ○ Treatment of illness 		<ul style="list-style-type: none"> • Child health (during pregnancy) <ul style="list-style-type: none"> ○ Immunizations ○ Access/quality of care 	During pregnancy <ul style="list-style-type: none"> • Child health and medical home • Dental care • Immunizations • Well-baby visits • Child sick care • Vision/hearing care 	During pregnancy <ul style="list-style-type: none"> • Child health • Fetal alcohol spectrum disorder 	During pregnancy <ul style="list-style-type: none"> • Immunizations
Maternal health (outside of pregnancy)	<ul style="list-style-type: none"> • Maternal health (outside pregnancy) <ul style="list-style-type: none"> • Preventive care and treatment 		<ul style="list-style-type: none"> • Access/quality of care • Health and wellness 	<ul style="list-style-type: none"> • General health • Health providers or services 	<ul style="list-style-type: none"> • General health 	
Family planning	<ul style="list-style-type: none"> • Family planning <ul style="list-style-type: none"> ○ Contraception ○ Birth spacing ○ Fertility 		<ul style="list-style-type: none"> • Family planning <ul style="list-style-type: none"> • Birth control 	<ul style="list-style-type: none"> • Family planning <ul style="list-style-type: none"> • Safe sex, STI 	<ul style="list-style-type: none"> • Family planning <ul style="list-style-type: none"> • Optimal birth spacing • Safe sex, STI 	<ul style="list-style-type: none"> • Family planning

(continued)

Appendix Table C.2 Mapping of Topic Categories Across Service Delivery Data Sources (continued)

MIHOPE-Strong Start Category	MIHOPE Family Service Log	NFP National Service Office MIS	State 1 HFA MIS	State 2 HFA MIS	State 3 HFA MIS	State 4 HFA MIS
Tobacco and substance use	<ul style="list-style-type: none"> • Tobacco, alcohol, and other drug use 		<ul style="list-style-type: none"> • Substance use • Smoking 	<ul style="list-style-type: none"> • Substance use • Smoking cessation 	<ul style="list-style-type: none"> • Substance use • Smoking cessation 	<ul style="list-style-type: none"> • Secondhand smoke
Mental health and stress	<ul style="list-style-type: none"> • Mental health or stress • Depression • Anxiety • Anger management 		<ul style="list-style-type: none"> • Mental health or wellness • Stress and anger management 	<ul style="list-style-type: none"> • Mental health • Parenting stress 	<ul style="list-style-type: none"> • Mental health • Parenting stress 	<ul style="list-style-type: none"> • Mental health • Reducing stressors
Intimate partner violence (IPV)	<ul style="list-style-type: none"> • IPV counseling/anger management 			<ul style="list-style-type: none"> • IPV • Safety planning 	<ul style="list-style-type: none"> • Violence in household 	<ul style="list-style-type: none"> • Safety planning
Breastfeeding, infant feeding, and nutrition	<ul style="list-style-type: none"> • Breastfeeding, infant feeding, and nutrition 		<ul style="list-style-type: none"> • Nutrition • Nutrition and feeding/elimination 	<ul style="list-style-type: none"> • Breastfeeding information and support • Infant/child feeding • Nutrition/food prep 	<ul style="list-style-type: none"> • Breastfeeding information and support • Infant/child feeding • Nutrition/food prep 	<ul style="list-style-type: none"> • Breastfeeding • Nutrition • Obesity
Child health	<ul style="list-style-type: none"> • Child health <ul style="list-style-type: none"> ○ Health status and health care use ○ Regular check-ups ○ Treatment of illness 		<ul style="list-style-type: none"> • Child health • Immunizations • Access/quality of care 	<ul style="list-style-type: none"> • Child health and medical home • Dental care • Immunizations • Well-baby visits • Child sick care • Vision/hearing care 	<ul style="list-style-type: none"> • Child health • Fetal alcohol spectrum disorder 	<ul style="list-style-type: none"> • Immunizations

(continued)

Appendix Table C.2 Mapping of Topic Categories Across Service Delivery Data Sources (continued)

MIHOPE-Strong Start Category	MIHOPE Family Service Log	NFP National Service Office MIS	State 1 HFA MIS	State 2 HFA MIS	State 3 HFA MIS	State 4 HFA MIS
Child safety	<ul style="list-style-type: none"> • Child/home safety <ul style="list-style-type: none"> ○ Injury prevention ○ Safety-proofing ○ Poisons ○ Fires ○ Car seats 		<ul style="list-style-type: none"> • Shaken baby • Safe sleep • Child passenger safety • Poisons 	<ul style="list-style-type: none"> • Shaken baby • Safe sleep • Safe and healthy home • Care seats • Child-proofing 	<ul style="list-style-type: none"> • Shaken baby • SIDS • Car seats • Child-proofing 	<ul style="list-style-type: none"> • Injury prevention • SIDS • Shaken baby • Co-sleeping • Car seats • Poison • Fire
		<ul style="list-style-type: none"> • Lead exposure in home 		<ul style="list-style-type: none"> • Hazardous substances and neurotoxins 		
Public assistance (includes health insurance)	<ul style="list-style-type: none"> • Public assistance/government assistance • Health insurance/Medicaid/SCHIP 			<ul style="list-style-type: none"> • Child welfare services • WIC • TANF 		
Housing	<ul style="list-style-type: none"> • Housing 		<ul style="list-style-type: none"> • Housing 	<ul style="list-style-type: none"> • Housing 	<ul style="list-style-type: none"> • Housing 	

SOURCES: MIHOPE family service logs, Nurse-Family Partnership (NFP) national service management information system (MIS) data, and state-specific and local-level Healthy Families America (HFA) MIS data.

NOTES: OB = obstetrics, SCHIP = State Children’s Health Insurance Program, SIDS = sudden infant death syndrome, STI = sexually transmitted infection, TANF = Temporary Assistance for Needy Families, WIC = Women, Infants, and Children program. Categories using NFP MIS data capture only referrals for the mother and index child, while those coming from HFA MIS data vary by state and may include information for other “family members” as defined by the individual state.

Appendix Table C.3

Priority Ratings for Intended Outcomes Across All Domains: Reports from Evidence-Based Models, Program Managers, and Home Visitors

Outcome to Address	Model Developer		Local Program Manager			Home Visitor		
	Rating (0 to 10)		Rating (0 to 10)			Rating (0 to 10)		
	HFA	NFP	Overall	HFA	NFP	Overall	HFA	NFP
<u>Birth outcomes</u>	9	10	9.2 (1.3)	8.9 (1.5)	9.4 (0.8)	9.2 (1.4)	8.9 (1.5)	9.5 (1.1)
<u>Maternal health and well-being</u>								
During pregnancy								
Health-related behaviors ^a	7	10	8.9 (1.1)	8.8 (1.3)	9.1 (0.9)	9.1 (1.3)	8.9 (1.5)	9.3 (1.1)
Outside of pregnancy								
Health-related behaviors ^b	7	10	8.0 (1.6)	8.1 (1.7)	7.8 (1.6)	7.9 (2.0)	8.0 (1.9)	7.7 (2.0)
Tobacco use	7	10	8.2 (1.8)	7.9 (1.9)	8.6 (1.6)	8.1 (1.9)	8.0 (2.1)	8.2 (1.8)
In general								
Family planning and birth spacing	7	10	8.8 (1.7)	8.5 (2.1)	9.1 (1.1)	8.7 (1.6)	8.6 (1.7)	8.9 (1.5)
Mental health and substance use	8	10	9.1 (1.1)	8.9 (1.4)	9.3 (0.8)	8.9 (1.4)	8.8 (1.5)	8.9 (1.3)
Intimate partner violence	8	10	9.2 (0.9)	9.1 (1.0)	9.3 (0.8)	8.9 (1.5)	8.9 (1.5)	8.8 (1.5)
<u>Parenting to support child health</u>								
Breastfeeding	10	10	9.0 (1.3)	8.7 (1.5)	9.3 (0.7)	9.0 (1.4)	8.7 (1.6)	9.2 (1.2)
Child preventive care	10	10	9.5 (0.8)	9.6 (0.7)	9.4 (0.8)	9.5 (1.0)	9.5 (1.0)	9.5 (0.9)
Child abuse and neglect	10	10	9.9 (0.3)	10.0 (0.2)	9.8 (0.4)	9.6 (0.9)	9.8 (0.8)	9.5 (1.1)
Healthy sleep habits for infants ^c								
Adequate hours of sleep	10	10	8.7 (1.5)	9.5 (0.7)	7.4 (1.6)	8.5 (1.7)	8.9 (1.4)	8.0 (1.9)

(continued)

Appendix Table C.3 Priority Ratings for Intended Outcomes (continued)

Outcome to Address (mean)	Model Developer		Local Program Manager			Home Visitor		
	Rating (0 to 10)		Rating (0 to 10)			Rating (0 to 10)		
	HFA	NFP	Overall	HFA	NFP	Overall	HFA	NFP
Discouraging bed-sharing	10	10	9.4 (0.9)	9.5 (0.7)	9.1 (1.1)	9.0 (1.5)	9.1 (1.7)	9.0 (1.2)
Putting the baby to sleep on his or her back	10	10	9.6 (0.9)	9.6 (0.7)	9.4 (1.1)	9.5 (1.0)	9.6 (1.0)	9.4 (1.1)
<u>Parenting to support child development</u>								
Child development	10	10	9.5 (0.8)	9.6 (0.9)	9.3 (0.8)	9.3 (1.1)	9.4 (1.1)	9.2 (1.0)
Positive parenting behavior	10	10	9.6 (0.8)	9.6 (0.9)	9.6 (0.6)	9.5 (0.9)	9.6 (0.9)	9.5 (1.0)
<u>Family economic self-sufficiency</u>								
	8	10	8.9 (1.2)	8.9 (1.2)	9.0 (1.2)	9.0 (1.3)	8.9 (1.4)	9.1 (1.2)
Sample size	1	1	66	37	29	393	210	183

SOURCES: Calculations based on data from the MIHOPE evidence-based model developer survey, the MIHOPE program manager baseline survey, the MIHOPE-Strong Start program manager survey, the MIHOPE home visitor baseline survey, and the MIHOPE-Strong Start home visitor survey.

NOTES: HFA = Healthy Families America, NFP = Nurse-Family Partnership.

Program manager and home visitor ratings are means. Standard deviations are shown in parentheses.

^aThe MIHOPE-Strong Start program manager and home visitor surveys ask about four specific outcomes related to promoting good prenatal health (good nutrition, proper exercise, proper rest, and reducing tobacco use). A staff member's highest rating among these four items was used as the staff member's priority rating for health-related behaviors during pregnancy.

^bThe MIHOPE-Strong Start program manager and home visitor surveys ask about three specific outcomes related to promoting maternal health outside of pregnancy (good nutrition, proper exercise, and proper rest). A staff member's highest rating among these three items was used as the staff member's priority rating for health-related behaviors outside of pregnancy.

^cQuestion was not asked in the MIHOPE program manager baseline survey or the MIHOPE home visitor baseline survey. The sample is taken from MIHOPE-Strong Start program manager and home visitor survey data only. Sample size for program managers: 18 (11 HFA and 7 NFP). Sample size for home visitors: 136 (78 HFA and 58 NFP).

Appendix Table C.4

**Local Programs' Policies for Information Gathering, Education and Support, and Referrals:
Maternal Mental Health, Maternal Substance Use, and Intimate Partner Violence**

Program Policy (%)	Maternal Mental Health			Maternal Substance Use			Intimate Partner Violence		
	Overall	HFA	NFP	Overall	HFA	NFP	Overall	HFA	NFP
<u>Information gathering</u>									
Formal screening is required ^a	93.9	94.6	93.1	75.8	64.9	89.7	74.2	67.6	82.8
At a specified time before or after a child's birth or enrollment ^b	93.9	94.6	93.1	74.2	62.2	89.7	74.2	67.6	82.8
Required prenatally	63.6	62.2	65.5	53.0	37.8	72.4	54.5	35.1	79.3
Shortly after birth (child is 0-2 months)	43.9	56.8	27.6	6.1	5.4	6.9	7.6	13.5	0.0
In first month after enrollment	28.8	29.7	27.6	24.2	21.6	27.6	16.7	18.9	13.8
When home visitor or parent has a concern ^b	42.4	32.4	55.2	19.7	5.4	37.9	21.2	13.5	31.0
<u>Education and support^c</u>									
Family education and support when screening detects problem									
Specified in written protocol or determined in consultation with supervisor ^b	77.3	91.9	58.6	54.5	62.2	44.8	56.1	64.9	44.8
Home visitors can decide on their own how to act ^b	13.6	2.7	27.6	12.1	0.0	27.6	13.6	2.7	27.6
No policy ^b	10.6	5.4	17.2	9.1	2.7	17.2	9.1	2.7	17.2

(continued)

Appendix Table C.4 Local Programs' Policies (continued)

Program Policy (%)	Maternal Mental Health			Maternal Substance Use			Intimate Partner Violence		
	Overall	HFA	NFP	Overall	HFA	NFP	Overall	HFA	NFP
Referral^c									
Role of home visitor in making referral									
Provide information to families	45.9	45.7	46.2	59.2	62.5	56.0	63.3	72.0	54.2
Help family gain access to resource	44.3	48.6	38.5	32.7	37.5	28.0	30.6	28.0	33.3
No policy	9.8	5.7	15.4	8.2	0.0	16.0	6.1	0.0	12.5
Role of home visitor in following through on referral									
Home visitor expected to monitor	91.8	97.1	84.6	91.7	95.8	87.5	91.8	100.0	83.3
Home visitor not expected to monitor	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
No policy	8.2	2.9	15.4	8.3	4.2	12.5	8.2	0.0	16.7
Sample size	66	37	29	66	37	29	66	37	29

SOURCES: Calculations based on data from the MIHOPE program manager baseline survey and the MIHOPE-Strong Start program manager survey.

NOTES: HFA = Healthy Families America, NFP = Nurse-Family Partnership.

^aPossible screening tools included options for many commonly used tools, state- or model-specific tools or screening questions, and respondent write-in options.

^bResponse categories are not mutually exclusive, so percentages may total more than 100. Since local programs could respond for more than one tool within each domain, some reported on more than one tool and might have different policies for each tool.

^cThis information was gathered only if the local program manager reported that a formal screening was required.

Appendix Table C.5

Supervision of Home Visitors: Local Program Policies, Frequency, and Perceived Helpfulness

Activity (%)	Local Program Manager			Home Visitor		
	Overall	HFA	NFP	Overall	HFA	NFP
<u>Local program policies on supervision</u>						
Has policy for one-on-one supervision of home visitors	95.4	100.0	89.7	NA	NA	NA
Has policy for observation of home visits by supervisor	93.8	97.2	89.7	NA	NA	NA
<u>Type and frequency of supervision^a</u>						
Weekly or more frequent one-on-one meetings with supervisors	NA	NA	NA	91.8	92.4	91.2
Frequency of group supervision meetings with supervisors						
Weekly or more frequently	NA	NA	NA	39.9	25.0	55.8
Every 2-3 weeks	NA	NA	NA	26.6	16.4	37.5
Monthly	NA	NA	NA	24.6	45.3	2.5
Less than monthly	NA	NA	NA	8.5	13.3	3.3
Never	NA	NA	NA	0.4	0.0	0.8
Number of visits observed by supervisor in the past 12 months ^b						
Never observed	NA	NA	NA	13.1	17.4	8.0
1 to 2 visits	NA	NA	NA	49.6	41.1	59.7
3 or more visits	NA	NA	NA	37.3	41.5	32.4
Supervisor provides frequent and helpful feedback after visit observation	NA	NA	NA	81.1	80.1	82.2
Sample size	66	37	29	393	210	183

SOURCES: Calculations based on data from the MIHOPE program manager baseline survey, the MIHOPE-Strong Start program manager survey, the MIHOPE home visitor baseline survey, and the MIHOPE-Strong Start home visitor survey.

NOTES: HFA = Healthy Families America, NFP = Nurse-Family Partnership, NA = not applicable.

^aResponses are self-reported from a survey at a single point in time.

^bObservations include those done by supervisor in person or through both video recording and in person.

Appendix Table C.6

**Frequency and Perceived Helpfulness of Supervisor Guidance,
by Content Area**

Outcome-Specific Category (%)	Overall	HFA	NFP
<u>Prenatal health</u>			
Supervisor provides guidance			
Never	7.2	7.2	7.2
Once every couple of months or less frequently ^a	23.4	22.0	25.0
Once a month	19.5	22.5	16.1
Once a week or once every two weeks	49.9	48.3	51.7
Supervisor provides helpful guidance ^b	78.1	76.2	80.2
<u>Maternal health outside of pregnancy</u>			
Supervisor provides guidance			
Never	6.7	7.2	6.1
Once every couple of months or less frequently ^a	27.8	25.0	31.1
Once a month	19.8	20.2	19.4
Once a week or once every two weeks	45.6	47.6	43.3
Supervisor provides helpful guidance ^b	72.9	66.7	79.9
<u>Substance use and mental health</u>			
Supervisor provides guidance			
Never	4.1	3.8	4.4
Once every couple of months or less frequently ^a	22.9	19.7	26.7
Once a month	24.5	25.0	23.9
Once a week or once every two weeks	48.5	51.4	45.0
Supervisor provides helpful guidance ^b	75.4	73.0	78.2
<u>Healthy adult relationships</u>			
Supervisor provides guidance			
Never	8.3	8.2	8.3
Once every couple of months or less frequently ^a	35.1	30.0	41.1
Once a month	18.6	18.4	18.9
Once a week or once every two weeks	38.0	43.5	31.7
Supervisor provides helpful guidance ^b	72.6	70.9	74.5

(continued)

Appendix Table C.6 Supervisor Guidance by Content Area (continued)

Outcome-Specific Category (%)	Overall	HFA	NFP
Parenting to support child health			
Supervisor provides guidance			
Never	5.7	4.8	6.7
Once every couple of months or less frequently ^a	17.1	12.1	22.8
Once a month	21.7	22.2	21.1
Once a week or once every two weeks	55.6	60.9	49.4
Supervisor provides helpful guidance ^b	81.0	80.1	82.0
Sample size	393	210	183

SOURCES: Calculations based on data from the MIHOPE home visitor baseline survey and the MIHOPE-Strong Start home visitor survey.

NOTES: HFA = Healthy Families America, NFP = Nurse-Family Partnership.

^aCategory includes home visitors who indicated that their supervisors provide guidance every couple of months, every six months, once a year, or less frequently than once a year.

^bSample includes all home visitors except those who indicated that their supervisors never provide guidance regarding the outcome-specific category. The sample size for this variable is thus slightly reduced. Sample sizes for "Supervisor provides helpful guidance" for each outcome-specific category are as follows:

Prenatal health: overall = 360, HFA = 193, NFP = 167.

Maternal health outside of pregnancy: overall = 361, HFA = 192, NFP = 169.

Substance use and mental health: overall = 370, HFA = 200, NFP = 170.

Healthy adult relationships: overall = 354, HFA = 189, NFP = 165.

Parenting to support child health: overall = 363, HFA = 196, NFP = 167.

Appendix Table C.7

Administrative Support: Program Monitoring, Continuous Quality Improvement, and Data Management

Activity (%)	Overall	HFA	NFP
<u>Program monitoring</u>			
Annual or biannual reporting on local program performance	78.8	83.8	72.4
Monitoring of selected aspects of operations ^a			
Referrals into program			
Number of referrals	98.5	100.0	96.6
Appropriateness of referrals	84.8	86.5	82.8
Family enrollment			
Family retention rates at specific points	93.9	97.3	89.7
Reasons for family dropout	93.9	91.9	96.6
Visits			
Visit frequency	100.0	100.0	100.0
Visit length	81.8	81.1	82.8
Mother no-show rates	71.2	67.6	75.9
Screening			
Maternal depression	93.9	91.9	96.6
Maternal substance use	68.2	67.6	69.0
Intimate partner violence	77.3	73.0	82.8
Child development	97.0	100.0	93.1
<u>Continuous quality improvement (CQI)</u>			
One or more CQI activities in the past 12 months	87.9	86.5	89.7
Staff members with dedicated time for CQI	66.7	70.3	62.1
<u>Data management</u>			
Use of management information system for program monitoring and quality improvement	92.2	94.4	89.3
Staff to assist with service-delivery data entry	74.2	54.1	100.0
Sample size	66	37	29

SOURCES: Calculations based on data from the MIHOPE program manager baseline survey and the MIHOPE-Strong Start program manager survey.

NOTES: HFA = Healthy Families America, NFP = Nurse-Family Partnership.

^aResponse categories are not mutually exclusive, so percentages may total more than 100.

Appendix Table C.8

Program Managers' Assessments of the Availability of Professional Consultants Across Service Areas

Consultant Area (%)	No Consultant Available			Consultant Provides Advice Only			Consultant Provides Direct Service or Both Advice and Direct Service		
	Overall	HFA	NFP	Overall	HFA	NFP	Overall	HFA	NFP
	Prenatal health	33.3	35.1	31.0	16.7	18.9	13.8	50.0	45.9
Maternal health outside of pregnancy	33.3	35.1	31.0	12.1	10.8	13.8	54.5	54.1	55.2
Substance use	34.8	37.8	31.0	7.6	8.1	6.9	57.6	54.1	62.1
Mental health	31.8	35.1	27.6	9.1	5.4	13.8	59.1	59.5	58.6
Healthy adult relationships	33.3	32.4	34.5	7.6	8.1	6.9	59.1	59.5	58.6
Parenting to support child health	34.8	35.1	34.5	12.1	10.8	13.8	53.0	54.1	51.7
Sample size	66	37	29	66	37	29	66	37	29

SOURCES: Calculations based on data from the MIHOPE program manager baseline survey and the MIHOPE-Strong Start program manager survey.

NOTE: HFA = Healthy Families America, NFP = Nurse-Family Partnership.

Appendix Table C.9
Family and Supervision Caseload Size Policies of Evidence-Based Models and Local Programs

Caseload Policy	Overall	HFA	NFP
<u>Home visitor caseloads</u>			
Evidence-based model policy on the maximum caseload size of families per home visitor ^a	NA	25	25
Local programs with same maximum as evidence-based model (%)	51.5	24.3	86.2
Local programs with lower maximum caseload size (%)	48.5	75.7	13.8
Sample size	66	37	29
<u>Supervisor caseloads</u>			
Evidence-based model policy on the maximum caseload size of full-time home visitors per full-time supervisor	NA	6	8
Local programs with higher maximum caseload size (%)	3.6	3.4	3.8
Local programs with same maximum as evidence-based model (%)	63.6	41.4	88.5
Local programs with lower maximum caseload size (%)	32.7	55.2	7.7
Number of home visitors supervised by the average supervisor ^b	6.6	5.5	7.9
Sample size	55	29	26

SOURCES: Calculations based on data from the MIHOPE evidence-based model developer survey, the MIHOPE program manager baseline survey, the MIHOPE-Strong Start program manager survey, and the MIHOPE and MIHOPE-Strong Start site-selection teams.

NOTES: HFA = Healthy Families America, NFP = Nurse-Family Partnership, NA = not applicable.

Percentages that are the same as, that are lower than, or that are higher than the evidence-based model reflect the share of local programs whose program managers' reported maximums are in agreement with, are lower than, or are higher than the maximum specified by their evidence-based model. No local programs reported having home visitor caseload limits higher than their evidence-based model maximum.

^aHFA: maximum of 15 when visits were weekly; no more than 25 on any schedule.

^bStandard deviations: overall = 1.33; HFA = 0.57; NFP = 0.59. Ranges: overall = 4; HFA = 2; NFP = 3.

Appendix Table C.10
Formal Agreements with Referral Partners and Reported Sources
for the Recruitment of Families

Referral Partner (%)	Local Programs with Formal Referral Agreements			Local Programs That Report Referrals from These Sources		
	Overall	HFA	NFP	Overall	HFA	NFP
Central intake system	36.9	50.0	20.7	44.6	50.0	37.9
Any organization excluding central intake system						
Hospitals	56.9	63.9	48.3	95.4	91.7	100.0
Health departments	35.4	50.0	17.2	64.6	72.2	55.2
Prenatal clinics	16.9	22.2	10.3	53.8	52.8	55.2
Child welfare agencies	27.7	30.6	24.1	83.1	69.4	100.0
WIC programs	18.5	22.2	13.8	52.3	52.8	51.7
Schools	30.8	38.9	20.7	72.3	69.4	75.9
Pediatric clinics	16.9	22.2	10.3	61.5	44.4	82.8
Other ^a	13.8	19.4	6.9	29.2	36.1	20.7
	10.8	2.8	20.7	29.2	16.7	44.8
Sample size	66	37	29	66	37	29

SOURCE: Calculations based on data from the MIHOPE program manager baseline survey and MIHOPE-Strong Start program manager survey.

NOTES: HFA = Healthy Families America, NFP = Nurse-Family Partnership, WIC = Women, Infants, and Children.

^aOther referral partners with formal agreements include Federally Qualified Health Centers, residential drug treatment programs, juvenile detention centers, family success centers, and community agencies. Other reported recruitment sources include Medicaid, maternal child health outreach programs, pregnancy testing centers, domestic violence shelters, residential drug treatment programs, juvenile detention centers, family resource centers, social service agencies, community agencies, and current or previous clients.

Appendix Table C.11

Program Managers' and Home Visitors' Assessments of Community Service Provider Availability, Accessibility, and Effectiveness

Type of Community Resource (%)	Local Program Manager									Home Visitor		
	Available to Refer Families			Available to Refer Families and Accessible ^a			Available to Refer Families, Accessible, and Rated Effective ^a			Service Provider Is Available, Accessible, and Rated Effective, and Home Visitor Knows Provider's Name		
	Overall	HFA	NFP	Overall	HFA	NFP	Overall	HFA	NFP	Overall	HFA	NFP
Prenatal care	95.4	94.6	96.4	75.4	75.7	75.0	70.8	70.3	71.4	71.1	71.9	70.2
Family planning and reproductive care	90.8	86.5	96.4	55.4	56.8	53.6	50.8	51.4	50.0	64.2	62.4	66.3
Substance use ^b	93.8	91.9	96.4	50.8	54.1	46.4	40.0	43.2	35.7	32.7	42.9	21.0
Mental health ^b	93.8	91.9	96.4	50.8	54.1	46.4	40.0	43.2	35.7	38.1	47.6	27.1
Shelter for intimate partner violence	92.3	89.2	96.4	58.5	54.1	64.3	56.9	54.1	60.7	49.6	50.5	48.6
Intimate partner violence counseling	84.6	89.2	78.6	50.8	62.2	35.7	38.5	48.6	25.0	37.6	44.3	29.8
Pediatric primary care	89.2	94.6	82.1	61.5	67.6	53.6	58.5	64.9	50.0	69.1	70.5	67.4
Sample size	66	37	29	66	37	29	66	37	29	393	210	183

SOURCES: Calculations based on MIHOPE and MIHOPE-Strong Start community services inventories, the MIHOPE home visitor baseline survey, and the MIHOPE-Strong Start home visitor survey.

NOTES: HFA = Healthy Families America, NFP = Nurse-Family Partnership.

All local programs that responded to the community services inventories were included in the calculations of the service provider measures. Responses of "don't know" and "no" were treated as non-yes responses.

In the measures used, "availability" refers to the presence of a service provider to which local home visiting programs can refer families, "accessibility" refers to the local program's perception of whether families face difficulties in obtaining these services, and "effectiveness" refers to the local program's perception of how well a service provider delivers services to meet families' needs.

^aIn the MIHOPE community services inventory, program managers were asked about two service providers for each service type. If at least one of these two providers was available to refer families and families experienced no access difficulties, then the local program was counted as having a service provider available and accessible (second panel). This approach also applies to service providers' availability, accessibility, and effectiveness rating (third panel).

^bIn the community services inventories, substance use and mental health were combined. Therefore program managers' perceptions of service providers' availability, accessibility, and effectiveness for substance use and mental health are identical.

Appendix Table C.12

**Dosage Measures Based on Date of Random Assignment
Among Program Group Families with Home Visits**

Service Delivery Measure	Overall		HFA		NFP	
	Mean	(SD)	Mean	(SD)	Mean	(SD)
Gestational age at random assignment (RA) in weeks	17.2	(7.0)	20.6	(7.4)	15.5	(6.1)
<u>Time between RA and first visit</u>						
Families who received first visit during pregnancy ^a						
Gestational age in weeks	19.6	(7.3)	23.7	(7.8)	17.599	(6.1)
Number of weeks between RA and first visit	2.0	(2.3)	2.6	(2.5)	1.7	(2.2)
Families who received first visit after birth ^b						
Child's age in weeks	7.4	(12.2)	7.5	(12.8)	7.0	—
Number of weeks between RA and first visit	22.9	(19.3)	23.0	(20.2)	22.0	—
<u>Duration of participation</u>						
Months of participation in home visiting, over entire study period ^c	11.3	(6.3)	9.9	(6.0)	12.0	(6.3)
During pregnancy	4.3	(2.0)	3.5	(1.9)	4.7	(2.0)
After birth until child is 12 months old	7.0	(5.0)	6.3	(5.0)	7.3	(5.0)
<u>Visit rate</u>						
Number of visits per month, over entire study period ^d	1.8	(0.7)	2.1	(1.0)	1.7	(0.5)
During pregnancy	1.8	(0.7)	1.7	(0.8)	1.8	(0.6)
After birth until child is 12 months old	1.5	(1.2)	2.0	(1.5)	1.3	(0.8)
Over entire study period, proportion of families with... ^e (%)						
0.1-0.9 visits per month enrolled	8.2	—	8.4	—	8.0	—
1.0-1.9 visits per month enrolled	53.4	—	31.6	—	64.6	—
2.0-2.9 visits per month enrolled	32.8	—	47.7	—	25.2	—
3.0 or more visits per month enrolled	5.6	—	12.2	—	2.2	—
Sample size	1,154		392		762	

(continued)

Appendix Table C.12 Dosage Among Families with Home Visits (continued)

SOURCES: Calculations based on data from the MIHOPE family service logs and management information systems.

NOTES: HFA = Healthy Families America, NFP = Nurse-Family Partnership, SD = standard deviation.

The sample includes program group families for whom information was available who had at least one home visit, who entered the study early enough for services to be measured through the week of the child's first birthday, and who did not experience a miscarriage.

Twelve families whose first visit occurred after birth are included in the pregnancy period calculations, and 242 families who received visits only during the pregnancy period are included in the year-after-birth calculations. They contribute "0" visits to the respective time period.

^aSample size = 1,142.

^bSample size = 12 (11 HFA and 1 NFP). Therefore, a standard deviation could not be calculated for NFP.

^cRange = 0.25 months to 20 months. Prenatal and after-birth duration may not add up to total duration due to rounding.

^dCalculated by dividing the number of visits received through the week of the child's first birthday by the family's duration of participation. Range = 0.1 visits per month to 11.8 visits per month.

^eCategories may not sum to 100 due to rounding.

Appendix Table C.13

Dosage and Referral Measures Among All Families in the Program Group

Service Delivery Measure	Overall		HFA		NFP	
	Mean	(SD)	Mean	(SD)	Mean	(SD)
Gestational age at random assignment in weeks	17.2	(7.0)	20.4	(7.4)	15.4	(6.1)
<u>Duration of participation</u>						
Months of participation in home visiting, over entire study period ^a	9.7	(7.0)	8.3	(6.6)	10.5	(7.1)
During pregnancy	3.7	(2.4)	2.9	(2.2)	4.1	(2.4)
After birth until child is 12 months old	6.0	(5.3)	5.3	(5.2)	6.4	(5.3)
Family still enrolled (%)						
At child's birth ^b	69.7	—	66.3	—	71.4	—
When child is 12 months old ^c	41.5	—	32.2	—	46.4	—
<u>Visit frequency and visit rate</u>						
Number of visits received, over entire study period ^d	18.3	(15.5)	19.7	(19.4)	17.5	(12.8)
During pregnancy	6.6	(4.9)	5.2	(4.8)	7.4	(4.8)
After birth until child is 12 months old	11.6	(12.5)	14.4	(16.8)	10.1	(9.1)
Number of visits per month, over entire study period ^e	1.6	(0.9)	1.8	(1.2)	1.5	(0.8)
During pregnancy	1.5	(0.9)	1.4	(1.0)	1.6	(0.8)
After birth until child is 12 months old	1.3	(1.2)	1.7	(1.6)	1.1	(0.9)
<u>Provision of at least one referral in category^f (%)</u>						
Prenatal health	36.5	—	26.7	—	41.9	—
Maternal health outside of pregnancy ^g	23.0	—	10.7	—	29.7	—
Family planning and birth spacing	17.4	—	14.9	—	18.7	—
Tobacco and substance use	5.2	—	7.3	—	4.1	—
Mental health and stress	24.5	—	26.7	—	23.3	—
Intimate partner violence	8.4	—	10.2	—	7.3	—
Breastfeeding, infant feeding, and nutrition	27.2	—	22.6	—	29.7	—
Child health and safety	31.3	—	20.5	—	37.2	—
Public assistance, including health insurance	42.7	—	35.0	—	46.8	—
Housing	24.5	—	26.0	—	23.6	—
Sample size	1,341		469		872	

(continued)

Appendix Table C.13 Dosage and Referral Among Program Group (continued)

SOURCES: Calculations based on data from the MIHOPE family service logs and management information systems.

NOTES: HFA = Healthy Families America, NFP = Nurse-Family Partnership, SD = standard deviation.

The sample includes all program group families, including those who never had a visit, for whom information was available; who entered the study early enough for services to be measured through the week of the child's first birthday; and who did not experience a miscarriage.

^aRange = 0 months to 20 months. Prenatal duration and after-birth duration may not add up to total duration due to rounding.

^bA family is considered still enrolled at the child's birth if the family received at least one visit during pregnancy and received a home visit four weeks before the child's birth, the week of the child's birth, or any time after the child's birth.

^cA family is considered still enrolled when the child is 12 months old if the family received a home visit two weeks before the child's first birthday, the week of the child's first birthday, or any time after the child's first birthday.

^dRange = 0 visits to 177 visits. Prenatal number of visits and after-birth number of visits may not add up to total number of visits due to rounding.

^eCalculated by dividing the number of visits received through the week of the child's first birthday by the family's duration of participation. Range = 0 visits per month to 11.8 visits per month.

^fReferrals were counted regardless of whether they were provided in the pregnancy period or the year after birth.

^gReferrals for maternal health outside of pregnancy should be unrelated to prenatal care, family planning, reproductive health care, or childbirth education. After-birth referrals for maternal health outside pregnancy would include referrals for postpartum check-ups.

Appendix Table C.14

Topics That Program Group Families Discussed with Home Visitors At Least Once

Category (%)	During Pregnancy			Year After Birth		
	Overall	HFA	NFP	Overall	HFA	NFP
<u>Maternal health and well-being</u>						
Prenatal health ^a	95.9	92.1	98.9	NA	NA	NA
Maternal health outside of pregnancy ^a	61.9	51.7	70.2	67.0	61.4	71.5
Family planning and birth spacing	46.5	42.4	49.9	64.4	59.2	68.7
Tobacco and substance use	49.2	34.2	61.9	22.1	25.0	19.7
Mental health and stress	73.6	64.8	80.9	67.6	64.0	70.7
Intimate partner violence ^b	30.3	22.3	36.8	22.0	25.3	19.3
<u>Parenting</u>						
Breastfeeding, infant feeding, nutrition	74.3	70.4	77.5	73.0	67.6	77.5
<u>Child health</u>						
Child health and safety	64.4	62.8	65.7	75.9	73.0	78.4
<u>Access to community resources and public services</u>						
Public assistance, including health insurance ^c	71.7	61.1	78.2	55.3	47.5	60.0
Housing ^a	47.9	43.0	51.8	45.5	41.2	49.0
Sample size	859	392	467	859	392	467

SOURCES: Calculations based on data from the MIHOPE family service logs and management information systems.

NOTES: HFA = Healthy Families America, NFP = Nurse-Family Partnership, NA = not applicable.

The sample includes program group families for whom information was available who received at least one home visit, who entered the study early enough for services to be measured through the week of the child's first birthday, and who did not experience a miscarriage.

Not every HFA management information system (MIS) collected information for each topic category, and no information on these topics was available from the NFP MIS. Sample size thus varies throughout.

^aOverall sample size: pregnancy period = 848; year after birth = 848.

^bOverall sample size: pregnancy period = 844; year after birth = 847.

^cOverall sample size: pregnancy period = 752; year after birth = 751.

Appendix Table C.15

Comparison of Characteristics Between Families Included in and Families Excluded from Service Delivery Analyses

Characteristic	Ever Received a Home Visit During Pregnancy			Dosage, Duration, and Referrals During Pregnancy Among Families Ever Visited		
	Analysis Sample	Excluded Sample	Difference P-Value	Analysis Sample	Excluded Sample	Difference P-Value
	Mean	Mean		Mean	Mean	
Family characteristics						
Average weeks of gestation at random assignment	17.1	17.8	0.312	NA	NA	NA
Average weeks of gestation at first home visit	NA	NA	NA	19.2	20.5	0.057
Mother's race/ethnicity (%)			0.153			0.082
Non-Hispanic white	19.4	13.1		20.0	14.3	
Non-Hispanic black	29.8	19.1		30.8	23.7	
Mexican or Mexican-American	26.0	31.0		25.5	28.1	
Other Hispanic	16.4	26.8		15.8	24.2	
Other/multiracial	8.5	10.1		7.9	9.6	
Mother is foreign-born (%)	22.6	26.6	0.595	23.6	23.6	0.997
Average age of mother in years	22.0	22.6	0.422	22.0	22.4	0.434
Mother's highest level of education (%)			0.042			0.509
Less than high school diploma or General Educational Development (GED) certificate	34.3	45.7		34.7	38.7	
Only high school diploma or GED	36.7	33.1		36.2	34.4	
More than high school diploma or GED	29.1	21.3		29.2	26.9	
Biological father lives in home (%)	36.7	42.2	0.369	36.2	40.0	0.233
Mother is food insecure ^a (%)	53.2	56.8	0.421	54.8	53.6	0.740
Maternal self-rated health is "poor" or "fair" (%)	10.5	11.8	0.619	10.2	11.3	0.584
Mother smoked prior to pregnancy or at enrollment ^b (%)	18.8	18.6	0.974	18.1	20.6	0.444

(continued)

Appendix Table C.15 Sample Comparison for Service Delivery Analyses (continued)

Characteristic	Ever Received a Home Visit During Pregnancy			Dosage, Duration, and Referrals During Pregnancy Among Families Ever Visited		
	Analysis Sample	Excluded Sample	Difference P-Value	Analysis Sample	Excluded Sample	Difference P-Value
	Mean	Mean		Mean	Mean	
Mother has mental health concerns ^c (%)	41.2	41.6	0.919	40.6	44.2	0.228
<u>Home visitor characteristics</u>						
Average years of home visiting experience	NA	NA	NA	6.4	7.1	0.509
Home visitor was directly observed by supervisor in past year (%)	NA	NA	NA	91.5	94.3	0.345
Frequency of supervisor guidance in prenatal health content ^d (%)			NA			0.827
Infrequent	NA	NA		28.3	29.7	
Moderate	NA	NA		18.0	20.8	
Frequent	NA	NA		53.8	49.5	
Average number of families in home visitor's caseload	NA	NA	NA	17.1	18.6	0.163
Home visitor intends to leave position in next 12 months (%)	NA	NA	NA	15.9	13.2	0.540
<u>Local program characteristics</u>						
High poverty rate in community ^e (%)	35.3	28.0	0.452	36.9	31.4	0.473
Average number of primary care physicians per 10,000 persons ^f	7.8	8.2	0.287	7.9	8.0	0.625
Program has staff members with time for continuous quality improvement (%)	69.2	69.2	0.998	74.0	60.4	0.064
Consultant available for direct services in prenatal health (%)	61.0	69.2	0.450	63.8	57.5	0.418
Prenatal service provider available, accessible, and effective ^g (%)	70.2	73.1	0.749	67.9	74.3	0.360

(continued)

Appendix Table C.15 Sample Comparison for Service Delivery Analyses (continued)

Characteristic	Ever Received a Home Visit During Pregnancy			Dosage, Duration, and Referrals During Pregnancy Among Families Ever Visited		
	Analysis	Excluded	Difference	Analysis	Excluded	Difference
	Sample	Sample		Sample	Sample	
	Mean	Mean	P-Value	Mean	Mean	P-Value
Evidence-based model (%)			0.837			0.384
Healthy Families America	34.7	36.8		31.9	38.5	
Nurse-Family Partnership	65.3	63.2		68.2	61.5	
Sample size	1,159	182		785	369	

SOURCES: Calculations based on data from the MIHOPE and MIHOPE-Strong Start family baseline surveys, state vital records, the MIHOPE family service logs, management information systems, the MIHOPE home visitor baseline survey, the MIHOPE-Strong Start home visitor survey, the MIHOPE program manager baseline survey, the MIHOPE-Strong Start program manager survey, the MIHOPE and MIHOPE-Strong Start community services inventories, 2014 American Community Survey (ACS) five-year estimates, 2010 U.S. Census data, and 2010 American Medical Association primary care physician files.

NOTES: NA = not applicable.

For all categorical variables, differences across samples were tested for statistical significance using a Pearson chi-square test, adjusting for clustering of families within local programs. For continuous variables, differences across samples were tested for statistical significance using an adjusted Wald test, adjusting for clustering of families within local programs.

^aMothers were classified as having food insecurity if they indicated any experience with food not lasting or worry about food running out in the previous year. These two screening items are from the U.S. Department of Agriculture's U.S. Household Food Security Survey Module.

^bCategory includes mothers with any smoking in the three months prior to pregnancy or with any current smoking at enrollment.

^cCategory includes mothers who scored at clinically elevated levels on a depressive symptoms scale or on an anxiety symptoms scale. Depressive symptoms were measured using a 10-item Center for Epidemiologic Studies Depression Scale (CES-D). A score of 8 or higher indicates clinically significant depressive symptoms. Anxiety was measured using the Generalized Anxiety Disorder 7-item scale (GAD-7). A score of 10 or higher indicates moderate or severe symptoms.

^dInfrequent supervision is defined as once every few months or less. Moderate supervision is defined as once a month. Frequent supervision is defined as weekly or every other week.

^eCategory indicates communities with an average family poverty rate of 25 percent or higher among census tracts of sample members at the local program site.

^fNumber corresponds to Primary Care Service Areas (PCSAs) of sample members at the local program site.

^gResponses of "don't know" and "no" were treated as non-yes responses.

Appendix Table C.16

**Models Examining Number of Home Visits During Pregnancy
Among Families Who Received a Visit**

Characteristic	Bivariate Associations			Adjusted Associations		
	Coefficient	90% Confidence Interval	P-Value	Coefficient	90% Confidence Interval	P-Value
<u>Family characteristics</u>						
Weeks of gestation at first home visit	-1.98	(-2.25, -1.71)	0.000	-1.92	(-2.24, -1.60)	0.000
Mother's race/ethnicity						
Non-Hispanic white (reference group)	NA	NA	NA	NA	NA	NA
Non-Hispanic black	-0.39	(-1.24, 0.47)	0.454	-0.36	(-1.10, 0.39)	0.432
Mexican or Mexican-American	-0.64	(-1.39, 0.10)	0.154	-0.83	(-1.56, -0.11)	0.060
Other Hispanic	-0.02	(-0.82, 0.77)	0.963	-0.36	(-1.11, 0.38)	0.425
Other/multiracial	0.15	(-0.78, 1.07)	0.791	0.10	(-0.74, 0.95)	0.840
Mother is foreign-born	-0.36	(-1.06, 0.34)	0.396	0.14	(-0.59, 0.87)	0.757
Mother's age in years	0.29	(-0.01, 0.58)	0.107	0.05	(-0.24, 0.34)	0.782
Mother's highest level of education						
Less than high school diploma or General Educational Development (GED) certificate (reference group)	NA	NA	NA	NA	NA	NA
Only high school diploma or GED	0.48	(-0.05, 1.00)	0.133	0.25	(-0.21, 0.70)	0.374
More than high school diploma or GED	0.59	(-0.10, 1.29)	0.162	0.09	(-0.63, 0.81)	0.830
Biological father lives in home	0.58	(0.12, 1.04)	0.040	0.20	(-0.27, 0.67)	0.489
Mother is food insecure ^a	0.14	(-0.36, 0.63)	0.650	-0.02	(-0.56, 0.53)	0.962
Maternal self-rated health is "poor" or "fair"	0.87	(0.08, 1.67)	0.072	0.21	(-0.51, 0.94)	0.630
Mother smoked prior to pregnancy or at enrollment ^b	0.21	(-0.33, 0.74)	0.525	-0.15	(-0.61, 0.30)	0.576
Mother has mental health concerns ^c	0.48	(0.05, 0.92)	0.069	0.51	(0.08, 0.93)	0.051
<u>Home visitor characteristics</u>						
Years of home visiting experience	-0.14	(-0.47, 0.20)	0.507	-0.10	(-0.39, 0.20)	0.588

(continued)

Appendix Table C.16 Models Examining Number of Home Visits (continued)

Characteristic	Bivariate Associations			Adjusted Associations		
	Coefficient	90% Confidence Interval	P-Value	Coefficient	90% Confidence Interval	P-Value
Direct observation by supervisor in past year	0.71	(-0.66, 2.09)	0.394	0.88	(-0.31, 2.07)	0.225
Frequency of supervisor guidance in prenatal health content ^d						
Infrequent (reference group)	NA	NA	NA	NA	NA	NA
Moderate	-0.17	(-1.01, 0.67)	0.742	-0.04	(-0.80, 0.72)	0.926
Frequent	0.17	(-0.42, 0.76)	0.629	-0.10	(-0.75, 0.54)	0.795
Number of families in home visitor's caseload	-0.02	(-0.40, 0.36)	0.931	-0.27	(-0.58, 0.03)	0.140
Home visitor intends to leave position in next 12 months	-1.18	(-1.84, -0.53)	0.003	-0.95	(-1.64, -0.25)	0.025
<u>Local program characteristics</u>						
High poverty rate in community ^e	0.02	(-1.01, 1.06)	0.972	0.31	(-0.51, 1.13)	0.533
Average number of primary care physicians per 10,000 persons ^f	0.38	(-0.01, 0.78)	0.107	0.27	(-0.04, 0.58)	0.145
Program has staff members with time for continuous quality improvement	0.03	(-0.91, 0.97)	0.959	0.30	(-0.38, 0.98)	0.462
Consultant available for direct services in prenatal health	0.71	(-0.20, 1.61)	0.202	0.18	(-0.56, 0.91)	0.692
Prenatal service provider available, accessible, and effective ^g	-0.22	(-1.29, 0.85)	0.731	0.16	(-0.61, 0.94)	0.731
Evidence-based model						
Healthy Families America (reference group)	NA	NA	NA	NA	NA	NA
Nurse-Family Partnership	1.97	(1.23, 2.71)	0.000	0.72	(-0.13, 1.58)	0.164
Constant	NA	NA	NA	11.04	(8.10, 13.98)	0.000
Number of families	785			785		
Number of home visitors	256			256		
Number of local programs	60			60		

(continued)

Appendix Table C.16 Models Examining Number of Home Visits (continued)

SOURCES: Calculations based on data from the MIHOPE and MIHOPE-Strong Start family baseline surveys, state vital records, the MIHOPE family service logs, management information systems, the MIHOPE home visitor baseline survey, the MIHOPE-Strong Start home visitor survey, the MIHOPE program manager baseline survey, the MIHOPE-Strong Start program manager survey, the MIHOPE and MIHOPE-Strong Start community services inventories, 2014 American Community Survey (ACS) five-year estimates, 2010 U.S. Census data, and 2010 American Medical Association primary care physician files.

NOTES: NA = not applicable.

For continuous variables (including gestational age at the time of the first home visit, mother's age, the home visitor's years of experience, the home visitor's caseload size, and the density of primary care physicians per 10,000 persons), the coefficient represents the predicted change associated with a one standard deviation increase in the measure. For categorical variables (such as the mother's race or ethnicity), the coefficient indicates the change in the number of home visits during pregnancy associated with the presence of the characteristic compared with the reference group (which is indicated in the table). All other measures are two-category measures, and the coefficient shown represents the increase or decrease in the number of home visits during pregnancy associated with the presence of the characteristic compared with its absence.

^aMothers were classified as having food insecurity if they indicated any experience with food not lasting or worry about food running out in the previous year. These two screening items are from the U.S. Department of Agriculture's U.S. Household Food Security Survey Module.

^bCategory includes mothers with any smoking in the three months prior to pregnancy or with any current smoking at enrollment.

^cCategory includes mothers who scored at clinically elevated levels on a depressive symptoms scale or on an anxiety symptoms scale. Depressive symptoms were measured using a 10-item Center for Epidemiologic Studies Depression Scale (CES-D). A score of 8 or higher indicates clinically significant depressive symptoms. Anxiety was measured using the Generalized Anxiety Disorder 7-item scale (GAD-7). A score of 10 or higher indicates moderate or severe symptoms.

^dInfrequent supervision is defined as once every few months or less. Moderate supervision is defined as once a month. Frequent supervision is defined as weekly or every other week.

^eCategory indicates communities with an average family poverty rate of 25 percent or higher among census tracts of sample members at the local program site.

^fNumber corresponds to Primary Care Service Areas (PCSAs) of sample members at the local program site.

^gResponses of "don't know" and "no" were treated as non-yes responses.

Appendix Table C.17

**Models Examining Months of Home Visiting During Pregnancy
Among Families Who Received a Visit**

Characteristic	Bivariate Associations			Adjusted Associations		
	Coefficient	90% Confidence Interval	P-Value	Coefficient	90% Confidence Interval	P-Value
<u>Family characteristics</u>						
Weeks of gestation at first home visit	-1.22	(-1.33, -1.11)	0.000	-1.16	(-1.28, -1.04)	0.000
Mother's race/ethnicity						
Non-Hispanic white (reference group)	NA	NA	NA	NA	NA	NA
Non-Hispanic black	-0.39	(-0.76, -0.02)	0.085	-0.30	(-0.60, 0.00)	0.098
Mexican or Mexican-American	-0.18	(-0.48, 0.12)	0.334	-0.30	(-0.58, -0.02)	0.079
Other Hispanic	0.03	(-0.31, 0.38)	0.880	-0.16	(-0.47, 0.14)	0.376
Other/multiracial	-0.27	(-0.66, 0.13)	0.272	-0.30	(-0.73, 0.13)	0.251
Mother is foreign-born	0.02	(-0.32, 0.35)	0.926	0.21	(-0.07, 0.49)	0.209
Mother's age in years	0.13	(0.00, 0.26)	0.111	-0.02	(-0.13, 0.09)	0.767
Mother's highest level of education						
Less than high school diploma or General Educational Development (GED) certificate (reference group)	NA	NA	NA	NA	NA	NA
Only high school diploma or GED	0.38	(0.10, 0.66)	0.026	0.24	(-0.02, 0.49)	0.123
More than high school diploma or GED	0.29	(0.02, 0.57)	0.076	0.06	(-0.18, 0.30)	0.697
Biological father lives in home	0.45	(0.22, 0.68)	0.001	0.23	(0.02, 0.43)	0.076
Mother is food insecure ^a	-0.06	(-0.31, 0.19)	0.703	-0.10	(-0.37, 0.16)	0.525
Maternal self-rated health is "poor" or "fair"	0.31	(-0.04, 0.67)	0.142	0.03	(-0.23, 0.30)	0.849
Mother smoked prior to pregnancy or at enrollment ^b	0.17	(-0.10, 0.44)	0.311	0.06	(-0.16, 0.28)	0.647
Mother has mental health concerns ^c	0.13	(-0.07, 0.34)	0.273	0.26	(0.09, 0.43)	0.011
<u>Home visitor characteristics</u>						
Years of home visiting experience	-0.04	(-0.21, 0.12)	0.670	-0.01	(-0.15, 0.12)	0.857

(continued)

Appendix Table C.17 Models Examining Months of Home Visiting (continued)

Characteristic	Bivariate Associations			Adjusted Associations		
	Coefficient	90% Confidence Interval	P-Value	Coefficient	90% Confidence Interval	P-Value
Direct observation by supervisor in past year	0.26	(-0.10, 0.63)	0.234	0.39	(0.04, 0.74)	0.068
Frequency of supervisor guidance in prenatal health content ^d						
Infrequent (reference group)	NA	NA	NA	NA	NA	NA
Moderate	0.01	(-0.37, 0.38)	0.981	0.02	(-0.27, 0.31)	0.902
Frequent	0.15	(-0.15, 0.45)	0.401	0.06	(-0.16, 0.28)	0.659
Number of families in home visitor's caseload	0.17	(0.04, 0.30)	0.027	0.03	(-0.07, 0.12)	0.657
Home visitor intends to leave position in next 12 months	-0.24	(-0.56, 0.08)	0.211	-0.16	(-0.46, 0.15)	0.398
<u>Local program characteristics</u>						
High poverty rate in community ^e	-0.06	(-0.51, 0.39)	0.825	0.12	(-0.14, 0.38)	0.452
Average number of primary care physicians per 10,000 persons ^f	0.15	(-0.07, 0.37)	0.265	0.13	(0.02, 0.23)	0.056
Program has staff members with time for continuous quality improvement	-0.11	(-0.50, 0.29)	0.658	0.09	(-0.11, 0.29)	0.464
Consultant available for direct services in prenatal health	0.37	(-0.06, 0.79)	0.156	-0.01	(-0.24, 0.21)	0.924
Prenatal service provider available, accessible, and effective ^g	-0.12	(-0.61, 0.37)	0.687	-0.02	(-0.23, 0.19)	0.901
Evidence-based model						
Healthy Families America (reference group)	NA	NA	NA	NA	NA	NA
Nurse-Family Partnership	1.24	(0.93, 1.56)	0.000	0.31	(0.04, 0.57)	0.055
Constant	NA	NA	NA	5.87	(4.99, 6.75)	0.000
Number of families	785			785		
Number of home visitors	256			256		
Number of local programs	60			60		

(continued)

Appendix Table C.17 Models Examining Months of Home Visiting (continued)

SOURCES: Calculations based on data from the MIHOPE and MIHOPE-Strong Start family baseline surveys, state vital records, the MIHOPE family service logs, management information systems, the MIHOPE home visitor baseline survey, the MIHOPE-Strong Start home visitor survey, the MIHOPE program manager baseline survey, the MIHOPE-Strong Start program manager survey, the MIHOPE and MIHOPE-Strong Start community services inventories, 2014 American Community Survey (ACS) five-year estimates, 2010 U.S. Census data, and 2010 American Medical Association primary care physician files.

NOTES: NA = not applicable.

For continuous variables (including gestational age at the time of the first home visit, mother's age, the home visitor's years of experience, the home visitor's caseload size, and the density of primary care physicians per 10,000 persons), the coefficient represents the predicted change associated with a one standard deviation increase in the measure. For categorical variables (such as the mother's race or ethnicity), the coefficient indicates the change in the months of home visiting during pregnancy associated with the presence of the characteristic compared with the reference group (which is indicated in the table). All other measures are two-category measures, and the coefficient shown represents the increase or decrease in the months of home visiting during pregnancy associated with the presence of the characteristic compared with its absence.

^aMothers were classified as having food insecurity if they indicated any experience with food not lasting or worry about food running out in the previous year. These two screening items are from the U.S. Department of Agriculture's U.S. Household Food Security Survey Module.

^bCategory includes mothers with any smoking in the three months prior to pregnancy or with any current smoking at enrollment.

^cCategory includes mothers who scored at clinically elevated levels on a depressive symptoms scale or on an anxiety symptoms scale. Depressive symptoms were measured using a 10-item Center for Epidemiologic Studies Depression Scale (CES-D). A score of 8 or higher indicates clinically significant depressive symptoms. Anxiety was measured using the Generalized Anxiety Disorder 7-item scale (GAD-7). A score of 10 or higher indicates moderate or severe symptoms.

^dInfrequent supervision is defined as once every few months or less. Moderate supervision is defined as once a month. Frequent supervision is defined as weekly or every other week.

^eCategory indicates communities with an average family poverty rate of 25 percent or higher among census tracts of sample members at the local program site.

^fNumber corresponds to Primary Care Service Areas (PCSAs) of sample members at the local program site.

^gResponses of "don't know" and "no" were treated as non-yes responses.

Appendix Table C.18

**Models Examining Receipt of At Least One Home Visit During Pregnancy
Among Families Randomly Assigned to the Program Group**

Characteristic	Bivariate Associations			Adjusted Associations		
	Coefficient	90% Confidence Interval	P-Value	Coefficient	90% Confidence Interval	P-Value
<u>Family characteristics</u>						
Weeks of gestation at random assignment	-0.01	(-0.02, 0.01)	0.574	-0.01	(-0.02, 0.01)	0.594
Mother's race/ethnicity						
Non-Hispanic white (reference group)	NA	NA	NA	NA	NA	NA
Non-Hispanic black	0.01	(-0.05, 0.07)	0.800	0.01	(-0.05, 0.07)	0.790
Mexican or Mexican-American	0.02	(-0.04, 0.08)	0.544	0.01	(-0.06, 0.07)	0.880
Other Hispanic	0.04	(-0.02, 0.10)	0.245	0.04	(-0.03, 0.10)	0.398
Other/multiracial	-0.02	(-0.11, 0.08)	0.752	-0.02	(-0.11, 0.07)	0.724
Mother is foreign-born	0.04	(0.01, 0.07)	0.032	0.05	(0.00, 0.09)	0.074
Mother's age in years	0.00	(-0.02, 0.01)	0.650	-0.01	(-0.03, 0.01)	0.564
Mother's highest level of education						
Less than high school diploma or General Educational Development (GED) certificate (reference group)	NA	NA	NA	NA	NA	NA
Only high school diploma or GED	-0.04	(-0.07, 0.00)	0.108	-0.03	(-0.07, 0.00)	0.156
More than high school diploma or GED	-0.01	(-0.04, 0.03)	0.765	0.00	(-0.04, 0.05)	0.848
Biological father lives in home	-0.01	(-0.04, 0.03)	0.704	-0.01	(-0.04, 0.03)	0.687
Mother is food insecure ^a	0.03	(-0.01, 0.06)	0.201	0.02	(-0.01, 0.06)	0.235
Maternal self-rated health is "poor" or "fair"	-0.02	(-0.07, 0.02)	0.414	-0.03	(-0.08, 0.03)	0.448
Mother smoked prior to pregnancy or at enrollment ^b	-0.01	(-0.05, 0.03)	0.663	0.00	(-0.05, 0.04)	0.949
Mother has mental health concerns ^c	0.02	(-0.01, 0.04)	0.278	0.02	(-0.01, 0.05)	0.274
<u>Local program characteristics</u>						
High poverty rate in community ^d	-0.03	(-0.08, 0.03)	0.458	-0.03	(-0.09, 0.02)	0.350

(continued)

Appendix Table C.18 Models Examining Receipt of a Home Visit (continued)

Characteristic	Bivariate Associations			Adjusted Associations		
	Coefficient	90% Confidence Interval	P-Value	Coefficient	90% Confidence Interval	P-Value
Average number of primary care physicians per 10,000 persons ^e	0.02	(-0.01, 0.04)	0.227	0.02	(-0.01, 0.04)	0.262
Program has staff members with time for continuous quality improvement	0.00	(-0.05, 0.05)	0.982	0.01	(-0.04, 0.06)	0.740
Consultant available for direct services in prenatal health	-0.02	(-0.07, 0.03)	0.495	-0.01	(-0.06, 0.03)	0.613
Prenatal service provider available, accessible, and effective ^f	0.01	(-0.06, 0.07)	0.820	0.01	(-0.06, 0.07)	0.868
Evidence-based model						
Healthy Families America (reference group)	NA	NA	NA	NA	NA	NA
Nurse-Family Partnership	0.03	(-0.02, 0.08)	0.294	0.02	(-0.03, 0.07)	0.606
Constant	NA	NA	NA	0.81	(0.65, 0.97)	0.000
Number of families	1,159			1,159		
Number of local programs	63			63		

SOURCES: Calculations based on data from the MIHOPE and MIHOPE-Strong Start family baseline surveys, state vital records, the MIHOPE family service logs, management information systems, the MIHOPE home visitor baseline survey, the MIHOPE-Strong Start home visitor survey, the MIHOPE program manager baseline survey, the MIHOPE-Strong Start program manager survey, the MIHOPE and MIHOPE-Strong Start community services inventories, 2014 American Community Survey (ACS) five-year estimates, 2010 U.S. Census data, and 2010 American Medical Association primary care physician files.

NOTES: NA = not applicable.

For continuous variables (including gestational age at the time of random assignment, mother's age, and the density of primary care physicians per 10,000 persons), the coefficient represents the predicted change associated with a one standard deviation increase in the measure. For categorical variables (such as the mother's race or ethnicity), the coefficient indicates the change in probability of ever receiving a home visit during pregnancy associated with the presence of the characteristic compared with the reference group (which is indicated in the table). All other measures are two-category measures, and the coefficient shown represents the change in probability of ever receiving a home visit during pregnancy associated with the presence of the characteristic compared with its absence.

^aMothers were classified as having food insecurity if they indicated any experience with food not lasting or worry about food running out in the previous year. These two screening items are from the U.S. Department of Agriculture's U.S. Household Food Security Survey Module.

^bCategory includes mothers with any smoking in the three months prior to pregnancy or with any current smoking at enrollment.

^cCategory includes mothers who scored at clinically elevated levels on a depressive symptoms scale or on an anxiety symptoms scale. Depressive symptoms were measured using a 10-item Center for Epidemiologic Studies Depression Scale (CES-D). A score of 8 or higher indicates clinically significant depressive symptoms. Anxiety was measured using the Generalized Anxiety Disorder 7-item scale (GAD-7). A score of 10 or higher indicates moderate or severe symptoms.

(continued)

Appendix Table C.18 Models Examining Receipt of a Home Visit (continued)

^dCategory indicates communities with an average family poverty rate of 25 percent or higher among census tracts of sample members at the local program site.

^eNumber corresponds to Primary Care Service Areas (PCSAs) of sample members at the local program site.

^fResponses of “don’t know” and “no” were treated as non-yes responses.

Appendix Table C.19

**Models Examining Receipt of Referral for Prenatal Health During Pregnancy
Among Families Who Received a Visit**

Characteristic	Bivariate Associations			Adjusted Associations		
	Coefficient	90% Confidence Interval	P-Value	Coefficient	90% Confidence Interval	P-Value
<u>Family characteristics</u>						
Weeks of gestation at first home visit	-0.06	(-0.08, -0.03)	0.000	-0.05	(-0.08, -0.02)	0.005
Mother's race/ethnicity						
Non-Hispanic white (reference group)	NA	NA	NA	NA	NA	NA
Non-Hispanic black	-0.03	(-0.11, 0.05)	0.590	-0.02	(-0.10, 0.06)	0.710
Mexican or Mexican-American	0.03	(-0.06, 0.12)	0.565	0.02	(-0.07, 0.12)	0.659
Other Hispanic	0.03	(-0.07, 0.13)	0.613	0.02	(-0.08, 0.12)	0.791
Other/multiracial	0.00	(-0.13, 0.13)	0.992	0.00	(-0.13, 0.12)	0.974
Mother is foreign-born	0.03	(-0.03, 0.09)	0.387	0.05	(-0.03, 0.12)	0.297
Mother's age in years	-0.01	(-0.04, 0.02)	0.645	-0.03	(-0.06, 0.00)	0.133
Mother's highest level of education						
Less than high school diploma or General Educational Development (GED) certificate (reference group)	NA	NA	NA	NA	NA	NA
Only high school diploma or GED	0.01	(-0.05, 0.08)	0.752	0.01	(-0.05, 0.08)	0.719
More than high school diploma or GED	-0.01	(-0.08, 0.07)	0.888	0.01	(-0.07, 0.08)	0.913
Biological father lives in home	0.02	(-0.03, 0.07)	0.437	0.01	(-0.03, 0.06)	0.595
Mother is food insecure ^a	0.06	(-0.01, 0.12)	0.161	0.05	(-0.02, 0.12)	0.209
Maternal self-rated health is "poor" or "fair"	0.11	(0.03, 0.20)	0.028	0.12	(0.03, 0.21)	0.024
Mother smoked prior to pregnancy or at enrollment ^b	0.00	(-0.07, 0.07)	0.978	0.00	(-0.07, 0.07)	0.982
Mother has mental health concerns ^c	0.04	(-0.03, 0.10)	0.362	0.03	(-0.04, 0.09)	0.482
<u>Home visitor characteristics</u>						
Years of home visiting experience	-0.03	(-0.06, 0.00)	0.126	-0.03	(-0.07, 0.00)	0.091

(continued)

Appendix Table C.19 Models Examining Referral for Prenatal Health (continued)

Characteristic	Bivariate Associations			Adjusted Associations		
	Coefficient	90% Confidence Interval	P-Value	Coefficient	90% Confidence Interval	P-Value
Direct observation by supervisor in past year	-0.04	(-0.18, 0.11)	0.660	-0.07	(-0.21, 0.08)	0.452
Frequency of supervisor guidance in prenatal health content ^d						
Infrequent (reference group)	NA	NA	NA	NA	NA	NA
Moderate	-0.03	(-0.12, 0.06)	0.548	-0.02	(-0.12, 0.08)	0.730
Frequent	-0.06	(-0.15, 0.03)	0.268	-0.06	(-0.15, 0.03)	0.272
Number of families in home visitor's caseload	0.02	(-0.03, 0.07)	0.463	0.01	(-0.04, 0.06)	0.737
Home visitor intends to leave position in next 12 months	0.02	(-0.07, 0.11)	0.725	-0.01	(-0.08, 0.06)	0.863
<u>Local program characteristics</u>						
High poverty rate in community ^e	-0.04	(-0.14, 0.06)	0.525	-0.05	(-0.15, 0.06)	0.457
Average number of primary care physicians per 10,000 persons ^f	0.03	(-0.02, 0.08)	0.399	0.03	(-0.01, 0.08)	0.194
Program has staff members with time for continuous quality improvement	0.02	(-0.08, 0.12)	0.766	0.01	(-0.08, 0.10)	0.848
Consultant available for direct services in prenatal health	0.08	(-0.02, 0.18)	0.204	0.08	(-0.01, 0.17)	0.152
Prenatal service provider available, accessible, and effective ^g	0.03	(-0.10, 0.15)	0.742	0.06	(-0.07, 0.18)	0.452
Evidence-based model						
Healthy Families America (reference group)	NA	NA	NA	NA	NA	NA
Nurse-Family Partnership	0.14	(0.04, 0.24)	0.021	0.09	(0.00, 0.19)	0.115
Constant	NA	NA	NA	0.51	(0.20, 0.82)	0.007
Number of families	785			785		
Number of home visitors	256			256		
Number of local programs	60			60		

(continued)

Appendix Table C.19 Models Examining Referral for Prenatal Health (continued)

SOURCES: Calculations based on data from the MIHOPE and MIHOPE-Strong Start family baseline surveys, state vital records, the MIHOPE family service logs, management information systems, the MIHOPE home visitor baseline survey, the MIHOPE-Strong Start home visitor survey, the MIHOPE program manager baseline survey, the MIHOPE-Strong Start program manager survey, the MIHOPE and MIHOPE-Strong Start community services inventories, 2014 American Community Survey (ACS) five-year estimates, 2010 U.S. Census data, and 2010 American Medical Association primary care physician files.

NOTES: NA = not applicable.

Families who received referrals for maternal physical health during pregnancy are included as receiving referrals for prenatal health (as such referrals are likely to be connected to prenatal health). For continuous variables (including gestational age at the time of the first home visit, mother's age, the home visitor's years of experience, the home visitor's caseload size, and the density of primary care physicians per 10,000 persons), the coefficient represents the predicted change associated with a one standard deviation increase in the measure. For categorical variables (such as the mother's race or ethnicity), the coefficient indicates the change in the probability of receiving a referral for prenatal health or maternal physical health during pregnancy associated with the presence of the characteristic compared with the reference group (which is indicated in the table). All other measures are two-category measures, and the coefficient shown represents the change in probability of receiving a referral for prenatal health or maternal physical health during pregnancy associated with the presence of the characteristic compared with its absence.

^aMothers were classified as having food insecurity if they indicated any experience with food not lasting or worry about food running out in the previous year. These two screening items are from the U.S. Department of Agriculture's U.S. Household Food Security Survey Module.

^bCategory includes mothers with any smoking in the three months prior to pregnancy or with any current smoking at enrollment.

^cCategory includes mothers who scored at clinically elevated levels on a depressive symptoms scale or on an anxiety symptoms scale. Depressive symptoms were measured using a 10-item Center for Epidemiologic Studies Depression Scale (CES-D). A score of 8 or higher indicates clinically significant depressive symptoms. Anxiety was measured using the Generalized Anxiety Disorder 7-item scale (GAD-7). A score of 10 or higher indicates moderate or severe symptoms.

^dInfrequent supervision is defined as once every few months or less. Moderate supervision is defined as once a month. Frequent supervision is defined as weekly or every other week.

^eCategory indicates communities with an average family poverty rate of 25 percent or higher among census tracts of sample members at the local program site.

^fNumber corresponds to Primary Care Service Areas (PCSAs) of sample members at the local program site.

^gResponses of "don't know" and "no" were treated as non-yes responses.

Appendix Table C.20

Variation in Service Delivery During Pregnancy Across Families, Home Visitors, and Local Programs

Service Delivery Measure	Mean or Percentage	Sample Size			Proportion of Variance at Each Level		
		Family	Home Visitor	Local Program	Family	Home Visitor	Local Program
Received a home visit during pregnancy (%)	86.2	1,159	NA	63	0.96	NA	0.04
Number of home visits during pregnancy ^a	8.2	785	256	60	0.77	0.12	0.11
Number of months of home visiting during pregnancy ^a	4.0	785	256	60	0.83	0.04	0.13
Received a referral for prenatal health during pregnancy ^a (%)	49.9	785	256	60	0.74	0.17	0.09

SOURCES: Calculations based on data from the MIHOPE and MIHOPE-Strong Start family baseline surveys, state vital records, the MIHOPE family service logs, management information systems, the MIHOPE home visitor baseline survey, the MIHOPE-Strong Start home visitor survey, the MIHOPE program manager baseline survey, the MIHOPE-Strong Start program manager survey, the MIHOPE and MIHOPE-Strong Start community services inventories, 2014 American Community Survey (ACS) five-year estimates, 2010 U.S. Census data, and 2010 American Medical Association primary care physician files.

NOTES: NA = not applicable.

The estimates shown represent the proportion of the variance that comes from each level (that is, the family level, the home visitor level, or the local program level) in the multivariate multilevel models. A value of 0.60 at a given level would mean that 60 percent of the total variance for a particular measure comes from that level.

^aThese outcomes were modeled only for families who received at least one home visit.

Appendix D

Details on the MIHOPE-Strong Start Outcome Measures

As described in Appendix A, there are two sources of data for measuring the prenatal, birth, and health care use outcomes examined in the Mother and Infant Home Visiting Program Evaluation-Strong Start (MIHOPE-Strong Start). These include vital records and Medicaid data. This appendix provides additional details on how the outcomes examined in the impact analysis in Chapter 4, “Estimated Impacts on Prenatal Health, Birth Outcomes, and Health Care Use in the First Year,” were constructed from these data sources.

Vital Records Outcomes

The vital records-derived outcomes in this report were measured from birth certificate and fetal death certificate data provided by the vital records agencies in different states.¹ These data take the form of one row per infant/fetus in the vital records data; most families have one row. Families with twins have two rows.

Health Behaviors During Pregnancy

Several measures of health behaviors during pregnancy were derived from birth certificate and fetal death certificate data. These data were used to construct an indicator of a woman’s smoking during the third trimester and measures of the level of smoking in the third trimester. The latter were based on the number of cigarettes women smoked per day, placing them into four groups: none; low (1-10 cigarettes per day); medium (11-20 cigarettes); and high (21 or more). In addition, a measure of smoking cessation by the third trimester was included to identify women who quit smoking in the third trimester. This measure was only calculated among the subgroup of women who smoked in the three months before pregnancy or during the first two trimesters (351 women).

A measure for recommended gestational weight gain was based on recommendations from the Institute of Medicine, which vary by prepregnancy body mass index (BMI). Women whose BMI showed they were underweight (a BMI of less than 18.5) were recommended to gain 28-40 pounds; women with a normal BMI (18.5-24.9) were recommended to gain 25-35 pounds; those with a BMI considered overweight (25.0-29.9) were recommended to gain 15-25 pounds; and those whose BMI defined them as obese (at least 30.0) were recommended to gain 11-20 pounds.² Prepregnancy BMI

¹Most births were recorded for data collection using the 2003 Revised U.S. Standard Certificate of Live Birth. Some births were recorded using the 1989 Standard Certificate of Live Birth. As a sensitivity check, the impact analysis regression models were run again, using a dummy for the old birth certificate as a covariate. The results did not substantively change (not shown).

²Rasmussen, Catalano, and Yaktine (2009).

and weight gain were calculated using the woman's prepregnancy weight, weight at delivery, and height (all measured with birth and fetal death certificate data).

Mother's Health Care Use During Pregnancy

Adequacy of prenatal care was measured according to a modified Kotelchuck Adequacy of Prenatal Care Utilization (APNCU) index: the APNCU-2 M. The index accounts for initiation of prenatal care, the ratio of observed to expected number of visits (based on gestational age), the difference between the number of observed and expected visits, and a threshold of receiving at least nine visits.³ Possible categories include Adequate Plus, Adequate, and Not Adequate. In this analysis, "adequate" includes both Adequate and Adequate Plus.

Birth Outcomes

Measures of birth outcomes were derived from birth certificate data using the infant's birth weight and obstetric estimate of gestation.⁴ Outcomes were defined as follows:

- **preterm births:** less than 37 weeks completed
- **low birth weight:** less than 2,500 grams
- **very low birth weight:** less than 1,500 grams
- **high birth weight:** greater than 4,000 grams
- **early births:** less than 39 weeks completed
- **very preterm births:** less than 32 weeks completed
- **small for gestational age:** discussed below
- **large for gestational age:** discussed below
- **average birth weight:** in grams
- **average obstetric estimate of gestation:** in weeks

³VanderWeele, Lantos, Siddique, and Lauderdale (2009).

⁴In a few cases, gestational age was set to "missing" due to an inconsistent weight being provided for gestational age according to the criteria published by Alexander et al. (1996, Table 1). Very high (implausible) birth weight-gestational age combinations are not uncommon in birth certificate data, believed to be caused by the miscoding of gestational age.

Fetal deaths were excluded from the analyses of birth outcomes.

To identify newborns who were small or large for gestational age, data on all births in the United States from 2010 to 2015 were used to estimate the distribution percentiles of birth weight in grams as a function of gestational age (in weeks).⁵ Infants with a birth weight below the 10th percentile for their gestational age were considered small for gestational age, while infants with a birth weight above the 90th percentile were considered large for gestational age. Percentile distributions were estimated using the lambda mu sigma (LMS) method,⁶ separated by sex (male or female); race and ethnicity (non-Hispanic white, non-Hispanic black, non-Hispanic Asian, non-multiracial Hispanic, multiracial, or other race/ethnicity); and plurality (singleton or multiple birth). Data on maternal race and ethnicity were obtained from the family baseline survey data.

Breastfeeding

The birth certificate data include an indicator of whether the infant was breastfed at the time of discharge. A comparison done by other researchers of birth certificate data and medical records from two states found that the two data sources had very similar reports of breastfeeding at discharge — 91 percent and 96 percent, respectively.⁷ However, there were also false discovery rates between 16 percent and 19 percent, which indicates that this information is more often reported on the birth certificate data than in medical records. Fetal deaths were excluded from these analyses.

Mother's Health Care Use at Delivery

Two outcomes related to a mother's health care use at delivery were derived from birth certificate data: (1) Cesarean section delivery and (2) Cesarean section delivery for nulliparous, singleton, vertex births. The former measures the rate of Cesarean deliveries among all live births; the latter measures the rate of Cesarean section deliveries among first-time mothers with a term, singleton baby in a nonbreech position. Fetal deaths were excluded from these analyses.

⁵Birth data are available on the Centers for Disease Control and Prevention website: http://www.cdc.gov/nchs/data_access/Vitalstatsonline.htm. Due to large sample sizes, growth curves for singleton births of non-Hispanic white mothers were estimated with a 50 percent random sample.

⁶Cole and Green (1992).

⁷Martin et al. (2013).

Medicaid Outcomes

The Medicaid-derived measures used in this report were sourced from Medicaid claims and enrollment data provided by states. Claims data usually take the form of one row per claim or claim detail, and an individual may have dozens or even hundreds of such rows. Each claim has fields indicating information about the patient and provider; dates of service; codes indicating primary and secondary diagnoses, procedures performed, and medications provided; and other information. For this analysis, each measure was defined using a set of codes (see Appendix Table D.1), and each claim record was marked if it contained the relevant code or codes. The relevant claims were then summarized into one row for each individual containing all information about that person's health care use. For example, if a person had three visits to the emergency department (ED), there would have been three rows (one for each ED visit) in the claims data; after the summary process, that person would have a single row indicating a total of three ED visits. Individuals who were not matched to the Medicaid data were considered to have zero Medicaid claims and enrollment in these measures, except for infants with evidence of a miscarriage or stillbirth (see Appendix A).

The Medicaid-derived measures focus on two time frames: pregnancy and the year (365 days) after the child's birth. For the measures capturing events during pregnancy, the entire prenatal period was examined, regardless of when the sample member entered the study. While it is challenging to separate Medicaid claims during pregnancy into events occurring before and after the date of entry into the study, impact estimates that include Medicaid utilization from the baseline period are still valid. (There is no reason to believe there would be differences between the research groups in prenatal health care use prior to study entry.) For most sample members, the prenatal period end date is essentially the date of the infant's birth (derived from vital records; Medicaid files; follow-up data collection; or, when vital and Medicaid data were missing, the infant's due date). If the pregnancy ended in a miscarriage or stillbirth, the prenatal period end date reflects the timing of that event.

Emergency Department Visits

Visits to the ED were examined for both sample mothers and infants. Measures of ED use include the number of visits and a binary indicator of whether any ED visit was observed. ED visits were defined using revenue codes, place of service codes, and procedure codes (CPT/HCPCS).⁸ ED visits were considered to be one day in length

⁸CPT refers to the Current Procedural Terminology code set maintained by the American Medical Association; HCPCS refers to Healthcare Common Procedure Coding System, which is based on the American Medical Association's CPT codes.

Appendix Table D.1

Codes Used in Defining Medicaid-Derived Health Care Measures

Indicator	Mother/Infant	Codes
Hospitalization	Both	Used state-specific guidance.
Emergency department visit	Both	<ul style="list-style-type: none"> • Non-inpatient • CPT codes^a • HCPCS codes^a • Place of service (POS) code: 23 [national code set] or value contains “Emergency” and no other POS [state-specific code sets] • Revenue codes: 0450-0459 or 0981 • State-specific guidance
Observation stay	Both	<ul style="list-style-type: none"> • CPT codes^a • Revenue codes: 0760, 0762 • State-specific guidance
Delivery hospitalization	Mother	<ul style="list-style-type: none"> • ICD-9 diagnosis codes <ul style="list-style-type: none"> ○ <u>Live:</u> 640.x1, 641.x1, 642.x1, 642.x2, 643.x1, 644.21, 645.x1, 646.x1, 646.x2, 647.x1, 647.x2, 648.x1, 648.x2, 649.x1, 649.x2, 650.x, 651.x1, 652.x1, 653.x1, 654.x1, 654.x2, 655.x1, 656.01, 656.11, 656.21, 656.31, 656.51, 656.61, 656.71, 656.81, 656.91, 657.01, 658.x1, 659.x1, 660.x1, 661.x1, 662.x1, 663.x1, 664.x1, 665.x1, 665.x2, 666.x2, 667.x2, 668.x1, 668.x2, 669.x1, 669.x2, 669.70, 670.02, 671.x1, 671.x2, 672.02, 673.x1, 673.x2, 674.x1, 674.x2, 675.x1, 675.x2, 676.x1, 676.x2, 678.x1, 679.x1, 679.x2, 763.4, V27.0x, V27.2x, V27.5x ○ <u>Cesarean:</u> 649.8, 669.7, 763.4 ○ <u>Terminations/non-live:</u> 630-639, 656.4, 768.0, 768.1, V27.1x, V27.4x, V27.7x ○ <u>Some live, some not:</u> V27.3x, V27.6x ○ <u>Unspecified live status:</u> V27.9x • ICD-9 procedure codes <ul style="list-style-type: none"> ○ <u>Live:</u> each code in range 72.0-74.2; 74.4, 74.99 ○ <u>Cesarean:</u> 74.0, 74.1, 74.2, 74.4, 74.99 ○ <u>Terminations/non-live:</u> 69.01, 69.51, 74.3, 74.91, 75.0

(continued)

Appendix Table D.1 Codes Used in Defining Medicaid-Derived Measures (continued)

Indicator	Mother/Infant	Codes
Delivery hospitalization (continued)	Mother	<ul style="list-style-type: none"> • ICD-10 diagnosis codes <ul style="list-style-type: none"> ○ <u>Live:</u> O360110-O360139, O360910-O360939, O361110-O361139, O361910-O361939, O3621X0-O3623X9, O365110-O365139, O365910-O365939, O3661X0-O3663X9, O3671X0-O3673X9, O368910-O368939, O3691X0-O403XX9, O43011, O43012, O43013, O43021, O43022, O43023, O43101, O43102, O43103, O43111, O43112, O43113, O43191, O43192, O43193, O43811, O43812, O43813, O43891, O43892, O43893, O4391, O4392, O4393, O6012X0-O6014X9, O6022X0-O6023X9, O68, O770, O771, O778, O779, O864, O8689, P034, Z370, Z372, Z3750, Z3751, Z3752, Z3753, Z3754, Z3759 ○ <u>Non-live/mixed/unspecified:</u> O000, O001, O002, O008, O009, O010, O011, O019, O020, O021, O0281, O0289, O029, O030, O031, O032, O0330, O0331, O0332, O0333, O0334, O0335, O0336, O0337, O0338, O0339, O034, O035, O036, O037, O0380, O0381, O0382, O0383, O0384, O0385, O0386, O0387, O0388, O0389, O039, O045, O046, O047, O0480, O0481, O0482, O0483, O0484, O0485, O0486, O0487, O0488, O0489, O070, O071, O072, O0730, O0731, O0732, O0733, O0734, O0735, O0736, O0737, O0738, O0739, O074, P84, Z332, Z371, Z374, Z377, Z373, Z3760, Z3761, Z3762, Z3763, Z3764, Z3769, Z379 • ICD-10 procedure codes <ul style="list-style-type: none"> ○ <u>Live:</u> 0Q820ZZ, 0Q823ZZ, 0Q824ZZ, 0Q830ZZ, 0Q833ZZ, 0Q834ZZ, 0U7C7ZZ, 0W8NXZZ, 10900ZC, 10903ZC, 10904ZC, 10907ZA, 10907ZC, 10908ZA, 10908ZC, 10A07Z6, 10D00Z0, 10D00Z1, 10D00Z2, 10D07Z3, 10D07Z4, 10D07Z5, 10D07Z6, 10D07Z7, 10D07Z8, 10E0XZZ, 10J07ZZ, 10S07ZZ, 10S0XZZ, 3E043VJ, 3E050VJ, 3E053VJ, 3E060VJ, 3E063VJ, 3E0DXGC, 3E0P7GC ○ <u>Non-live:</u> 10A00ZZ, 10A03ZZ, 10A04ZZ, 10A07ZX, 10A07ZZ, 10A08ZZ, 10T20ZZ, 10T23ZZ, 10T24ZZ • CPT codes^a • Revenue code: 0724
Birth hospitalization	Infant	<ul style="list-style-type: none"> • ICD-9 diagnosis codes: V30.xx-V37.xx, V39.xx • ICD-10 diagnosis codes: Z3800, Z3801, Z381, Z382, Z3830, Z3831, Z384, Z385, Z3861, Z3862, Z3863, Z3865, Z3868, Z387, Z388 • Birth Cesarean: Z3864, Z3866, Z3869

(continued)

Appendix Table D.1 Codes Used in Defining Medicaid-Derived Measures (continued)

Indicator	Mother/Infant	Codes
Well-child visit	Infant	<ul style="list-style-type: none"> • Non-inpatient • CPT codes^a • HCPCS codes^a • ICD-9 diagnosis codes: V20.2x, V20.3x, V70.0x, V70.3x, V70.5x, V70.6x, V70.8x, V70.9x • ICD-10 diagnosis codes: Z0000, Z0001, Z00110, Z00111, Z00121, Z00129, Z005, Z0070, Z0071, Z008, Z020, Z021, Z022, Z023, Z024, Z025, Z026, Z0282, Z0289, Z1388, Z77011
Immunization	Infant	<ul style="list-style-type: none"> • Non-inpatient • CPT codes^a • HCPCS codes^a • ICD-9 diagnosis codes: V03xx, V04xx, V05xx, V06xx • ICD-9 procedure codes: 993x, 994x, 995x • ICD-10 diagnosis codes: Z23 • ICD-10 procedure codes: 3E0134Z, 3E0234Z • Revenue code: 0771
Postpartum bundled services	Mother	<ul style="list-style-type: none"> • Non-inpatient • CPT codes^a
Postpartum visit	Mother	<ul style="list-style-type: none"> • Non-inpatient • CPT codes^a • HCPCS codes^a • ICD-9 diagnosis codes: V24.1x, V24.2x, V72.3x, V72.31, V72.32, V76.2x • ICD-9 procedure code: 89.26 • ICD-10 diagnosis codes: Z01411, Z01419, Z0142, Z124, Z391, Z392 • ICD-10 procedure codes: 8E0UXY7
Any level 3 or 4 NICU utilization	Infant	<ul style="list-style-type: none"> • Inpatient • Revenue codes: 0173-0175, 0203

NOTES: CPT = Current Procedural Terminology, HCPCS = Healthcare Common Procedure Coding System, ICD = International Classification of Diseases, NICU = neonatal intensive care unit.

^aCPT and HCPCS codes are not shown in the table for proprietary reasons. See text in Appendix D for details about measure construction.

regardless of the dates of service recorded on the claim; if multiple days were recorded, the start date of service was used as the date of the ED visit. ED visits that occurred concurrently with an inpatient stay or with an observation stay (defined below) that resulted in an inpatient stay were excluded. ED visits that occurred during an observation stay without an inpatient admission were considered an ED visit only.

Hospital Observation Stays

Hospital observation stays are outpatient services that help the doctor decide whether the patient needs to be admitted as an inpatient or can be discharged. Observation services may be given in the ED or another area of the hospital.

Observation stays were defined using CPT codes and revenue codes. Observation stay claims with overlapping or immediately adjacent dates were grouped together as one observation stay. Observation stays that resulted in an inpatient admission were excluded from this measure; an observation stay was considered to result in an inpatient admission if the dates for the observation stay and the inpatient event overlapped at any point. If an ED visit and an observation stay occurred simultaneously and neither resulted in an inpatient admission, the event was considered an ED visit only and not included as an observation stay.

Enrollment in Medicaid

Enrollment in Medicaid was examined for both mothers and infants. Measures of enrollment include the proportion of the time period the individual was enrolled in Medicaid and the binary measure of whether the individual was continuously enrolled for the entire time period or was only enrolled for part of the time period. These measures were examined for the prenatal period and the child's first year and created using each individual's Medicaid enrollment records.

Infant Admitted to Neonatal Intensive Care Unit

Neonatal intensive care unit (NICU) services were identified by revenue codes claimed under either the infant's or the mother's Medicaid ID. Only Level III or Level IV NICU services that began on, or within 30 days of, the infant's date of birth were included. Measures of NICU utilization include a binary indicator of whether the infant was admitted to the NICU and the length of the NICU admission, which is measured in days. The length of NICU admission is the sum of the number of days of NICU utilization for all services beginning within 30 days of birth. In states where dates of service for discrete services within inpatient claims were not available, hospital admission and discharge dates were used (this was done in fewer than 20 cases).

Hospitalizations and Related Care

A number of measures in this study are based on a definition of hospitalizations in the Medicaid data. These include measures of birth hospitalizations and nonbirth hospitalizations for infants, and delivery hospitalizations for mothers. Hospitalizations were identified using state-specific information rather than any nationally standard codes because states capture hospitalizations in different ways. Typically, a claim-type variable with a value such as “facility inpatient” was used. A hospitalization was defined as one or more overnight stays in an acute care inpatient setting.

Claims that indicated a hospitalization were grouped into utilization events. Multiple inpatient claims were grouped as one utilization event if they had dates that overlapped or if one event began the day after another one ended. This grouping process was also used for all services individual providers rendered during an inpatient event that might not be included on the claim submitted by the hospital. Services that occurred during an inpatient stay, such as immunizations, well-child visits, and postpartum care, were considered part of the inpatient stay for the purposes of calculating the length of the stay. This also affected the calculation of the number of preventive care-related visits during the year after the child’s birth (typically conducted in an outpatient setting), as services that are part of an inpatient stay were excluded from those counts. If an observation stay immediately preceded the hospital admission date, the start date of the observation stay was considered the true admission date. The length of a hospital stay was defined inclusively as the earliest hospital admission date in all the claim lines for the event minus the latest discharge date in all the claim lines for the event.

Hospitalization for infant birth. Infant birth hospital stays were defined using diagnosis codes from the ninth and tenth revisions of the International Classification of Diseases (ICD-9 and ICD-10). Measures include a binary indicator of whether a claim for a birth stay was recorded and the average number of days for a birth hospitalization. For these measures, any claims with birth codes in an inpatient setting were included, regardless of whether they were claimed under the infant’s or the mother’s Medicaid ID. For infants without a hospital claim for a birth stay, the Place of Service code from professional claims was used to find hospital births.

Hospitalization for delivery. Deliveries were defined using ICD-9 and ICD-10 diagnosis and procedure codes, CPT codes, and revenue codes for mothers. Both live and nonlive deliveries were included. Only inpatient hospital claims were used to identify

a delivery stay.⁹ If more than one inpatient delivery event was identified for an individual,¹⁰ the measure used the chronologically latest live delivery event.

Nonbirth hospitalizations. Nonbirth hospitalizations for infants were defined as any hospitalization not identified as a birth hospitalization. Measures of nonbirth hospitalizations include a binary measure of whether a child had any nonbirth hospitalizations, the number of nonbirth hospitalizations, and the number of days for nonbirth hospitalizations.

Well-Child Office Visits

Measures of well-child visits include the number of such visits and the proportion of the recommended number of well-child visits the family attended. The proportion of recommended visits was grouped into three categories of compliance: (1) 0-50 percent of recommended visits attended, (2) 51-75 percent of visits attended, and (3) more than 75 percent of visits attended. Well-child visits were defined using CPT and HCPCS codes and ICD-9 and ICD-10 diagnosis and procedure codes. Only one office visit per date of service was counted. An examination that occurred as part of an inpatient stay was not included in this count of well-child visits. The recommended number of visits was based on the American Academy of Pediatrics schedule.¹¹

Immunizations

Immunizations were measured for the infant only. Measures include a binary indicator of the child having had at least one immunization in the first year and the number of immunizations received that year. Immunizations were defined using CPT and HCPCS codes, ICD-9 and ICD-10 diagnosis and procedure codes, and revenue codes. This measure excludes immunizations that occurred during any inpatient stay, including the birth stay, in order to increase variation in the measure, because the first immunization during the birth stay was nearly universal within our sample.

⁹This includes deliveries at birth centers.

¹⁰Multiple delivery events sometimes happen with early labor or “false alarm” health care utilization events.

¹¹American Academy of Pediatrics, Committee on Practice and Ambulatory Medicine, Bright Futures Periodicity Schedule Workgroup (2017). These compliance measures were adjusted for the fact that some infants did not have the complete 12 months of follow-up data. For example, if only 10 months of data were available for an infant, then the well-child compliance rate was calculated based on the number of well-child visits recommended through 10 months of age rather than through the full 12 months. Additionally, the compliance measures were calculated without regard to gaps in enrollment.

For the number of immunizations, duplicate claims for specifically named immunizations occurring on the same date were counted as one immunization. For example, if a child had two claims for a varicella vaccination on the same date, only one counted toward the total number of immunizations for that child. (This situation occurs frequently in claims data because the preparation and administering of a vaccination are often submitted as separate claims.) On the other hand, if a child had one claim for a varicella vaccination and one claim for an influenza vaccination on the same day, this was counted as two immunizations.

Some immunization claims did not specify the name of the vaccination but only included codes for a general (nonspecific) administration of a vaccination. For each unique date in a child's claims history, the number of immunizations measure counted the immunizations received on that date. The count was calculated differently depending on whether the immunizations were specifically named or the claims were for a general, nonspecific administration of a vaccination. If both types of claims were submitted for the child on the same date, the higher of the two counts was used. The immunization counts for each date in a child's claims history were then summed to produce a total count for that child.

Postpartum Visit or Postpartum Bundled Service

Postpartum services were defined for mothers using the CPT and HCPCS codes and the ICD-9 and ICD-10 diagnosis and procedure codes, and bounded by the time period of 21-56 days after the prenatal period end date. This time period is specified in the Healthcare Effectiveness Data and Information Set (HEDIS) for the definition of postpartum care.¹² Claims occurring during an inpatient stay were not included as postpartum visits.

¹²National Committee for Quality Assurance (2017).

Appendix E

Sensitivity Checks for the Main Impact Analyses

This appendix presents several sensitivity checks to the main impact analyses in the Mother and Infant Home Visiting Program Evaluation-Strong Start (MIHOPE-Strong Start). The main impact results are shown in Chapter 4, “Estimated Impacts on Prenatal Health, Birth Outcomes, and Health Care Use in the First Year.” The analyses were prespecified to employ linear regression and not to impute for missing data or to minimize outliers.

The tables that follow in Appendix E show several sensitivity checks to the following impact results:

- Impact estimates that are not adjusted for family baseline characteristics or local programs (Appendix Table E.1)
- An analysis that uses multiple imputations to fill in missing Medicaid data for infants enrolled for only part of the year after birth (Appendix Table E.2)
- Impact results that exclude families with extreme values on key Medicaid outcomes (Appendix Table E.3)
- Logistic regression results for binary outcomes (Appendix Table E.4)

As noted in Chapter 4, these additional analyses are consistent with the findings presented in the report.

Appendix Table E.1
Unadjusted Effects on Confirmatory Outcomes

Outcome	Program Group	Control Group	Difference (Impact)	P-Value	90% Confidence Interval
<u>Maternal health in pregnancy (%)</u>					
Any smoking during third trimester	10.1	9.3	0.8	0.538	(-1.3, 2.8)
<u>Birth outcomes and related care (%)</u>					
Low birth weight (< 2,500 grams)	11.8	11.6	0.2	0.857	(-1.9, 2.4)
Preterm birth (< 37 weeks)	10.6	9.4	1.2	0.336	(-0.9, 3.3)
Admitted to neonatal intensive care unit (NICU) ^a	10.1	9.5	0.6	0.604	(-1.3, 2.5)
<u>Breastfeeding (%)</u>					
Infant was breastfed at discharge	79.0	77.9	1.0	0.599	(-2.2, 4.2)
<u>Infant health care use in first year</u>					
Any emergency department (ED) visits ^a (%)	51.6	51.4	0.2	0.916	(-3.0, 3.4)
Any nonbirth hospitalizations ^a (%)	5.4	6.8	-1.4	0.135	(-2.9, 0.1)
Average number of well-child office visits ^a	3.7	3.7	0.0	0.910	(-0.2, 0.2)
Sample size (total = 2,896)	1,569	1,327			

SOURCES: Calculations based on state vital records and Medicaid enrollment and claims data.

NOTES: The p-value indicates the likelihood of estimating an impact of this magnitude or larger if the intervention had zero effect.

^aThis measure only accounts for health care use paid for by Medicaid.

Appendix Table E.2

Estimated Effects on Confirmatory Outcomes of Infant Health Care Use in the First Year Calculated with Multiple Imputation

Outcome	Program Group	Control Group	Difference (Impact)	P-Value	90% Confidence Interval
Any emergency department (ED) visits (%)	68.1	68.7	-0.5	0.796	(-4.6, 3.5)
Any nonbirth hospitalizations (%)	6.7	8.8	-2.1	0.082	(-4.4, 0.3)
Average number of well-child office visits	4.8	4.8	-0.1	0.440	(-0.2, 0.1)
Sample size (total = 2,205)	1,188	1,017			

SOURCES: Calculations based on Medicaid enrollment and claims data.

NOTES: Estimates were regression-adjusted using generalized least squares, controlling for pre-random assignment characteristics of sample members and weighted to adjust for differing random assignment ratios used in MIHOPE and MIHOPE-Strong Start. Pre-random assignment characteristics were mean centered and interacted with the treatment variable to reduce the potential for bias since the sample was not randomized in equal numbers to the program and control groups.

This table shows impact estimates after imputing data for infants enrolled in Medicaid for only a portion of the first year after birth. Infants who did not match to Medicaid data and cases of miscarriage or infant death were excluded from the analysis. Data were imputed using SAS's PROC MI. The MONOTONE statement was used to impute data by month, allowing any existing claims data to be incorporated into the imputation model. All main impact model covariates were also included in the model. The imputation method specified was REGPMM, predictive mean matching. The procedure predicts values for an imputed variable for all observations in the data set and then fills a missing value by randomly selecting a nonmissing value from a set of cases that most closely match on the predicated values. The size of the set of cases used was 15. Twenty-five data sets with imputed values were generated, the impact model was run on each data set, and the impact estimates were combined using SAS's MIANALYZE procedure.

Appendix Table E.3

Estimated Effects on Continuous Health Care Use Outcomes, Winsorized at 1 Percent

Outcome	Program Group	Control Group	Difference (Impact)	P-Value	90% Confidence Interval
<u>Maternal health during pregnancy</u>					
<u>Health care use during pregnancy</u>					
Average number of emergency department (ED) visits	1.4	1.4	0.0	0.787	(-0.1, 0.1)
<u>Birth outcomes and related care</u>					
<u>Infant's health care use at birth</u>					
Average length of neonatal intensive care unit (NICU) admission (days)	1.4	1.0	0.4	0.027	(0.1, 0.7)
Average length of birth hospitalization (days)	3.8	3.5	0.3	0.166	(-0.1, 0.7)
<u>Mother's health care use at delivery</u>					
Average length of delivery hospitalization (days)	2.9	2.8	0.1	0.382	(-0.1, 0.2)
<u>Maternal and infant health care use and coverage in first year</u>					
<u>Infant health care use</u>					
Average number of ED visits	1.3	1.5	-0.1	0.070	(-0.2, 0.0)
Average number of nonbirth hospitalizations	0.1	0.1	0.0	0.177	(0.0, 0.0)
Average length for nonbirth hospitalization (days)	0.3	0.3	0.0	0.648	(-0.1, 0.1)
Average number of immunizations	8.1	8.0	0.1	0.617	(-0.3, 0.6)
<u>Maternal health care use</u>					
Average number of ED visits	1.0	1.1	-0.1	0.053	(-0.2, 0.0)
Sample size (total = 2,896)	1,569	1,327			

(continued)

Appendix Table E.3 Winsorized Outcomes (continued)

SOURCES: Calculations based on Medicaid enrollment and claims data.

NOTES: Estimates were regression-adjusted using generalized least squares, controlling for pre-random assignment characteristics of sample members and weighted to adjust for differing random assignment ratios used in MIHOPE and MIHOPE-Strong Start. All measures only account for health care use paid for by Medicaid.

This table shows impact estimates excluding extreme values. Rare health issues resulted in small numbers of extreme values in some health care use measures. For this table, continuous measures were winsorized (top- and bottom-coded) at 1 percent. That is, the top percentile was filled with the value of the 99th percentile, and the bottom percentile was filled with the value of the 2nd percentile.

The p-value indicates the likelihood of estimating an impact of this magnitude or larger if the intervention had zero effect.

Appendix Table E.4
Estimated Effects on Binary Confirmatory Outcomes
Calculated with Logistic Regression

Outcome (%)	Program Group	Control Group	Difference (Impact)	P-Value	90% Confidence Interval
<u>Maternal health in pregnancy</u>					
Any smoking during third trimester	10.1	9.5	0.6	0.673	(-0.8, 1.9)
<u>Birth outcomes and related care</u>					
Low birth weight (< 2,500 grams)	11.7	11.6	0.1	0.968	(-1.8, 2.0)
Preterm birth (< 37 weeks)	10.6	9.6	1.0	0.312	(-0.9, 2.9)
Infant admitted to neonatal intensive care unit (NICU) ^a	10.0	9.5	0.5	0.392	(-1.3, 2.4)
<u>Breastfeeding initiation</u>					
Infant was breastfed at discharge	78.9	78.0	0.8	0.747	(-2.1, 4.0)
<u>Infant health care use in the first year</u>					
Any emergency department (ED) visits ^a	51.5	51.6	0.0	0.799	(-3.2, 3.1)
Any nonbirth hospitalizations ^a	5.4	6.8	-1.4	0.159	(-2.9, 0.0)
Sample size (total = 2,896)	1,569	1,327			

SOURCES: Calculations based on state vital records and Medicaid enrollment and claims data.

NOTES: Estimates were regression-adjusted using a logit model, controlling for pre-random assignment characteristics of sample members and weighted to adjust for differing random assignment ratios used in MIHOPE and MIHOPE-Strong Start. The logit model includes a G-computation estimator to obtain the average effect and a nonparametric bootstrap to obtain the correct standard error estimate for computing the p-value.

^aThis measure only accounts for health care use paid for by Medicaid.

Appendix F

Results of Impact Analyses by Family Subgroups

In addition to the main impact analysis shown and discussed in Chapter 4, “Estimated Impacts on Prenatal Health, Birth Outcomes, and Health Care Use in the First Year,” the study team examined home visiting effects for the eight confirmatory outcomes in Mother and Infant Home Visiting Program Evaluation-Strong Start (MIHOPE-Strong Start) across four types of family characteristics. These family characteristics are considered exploratory, and include:

- **The mother’s race and ethnicity:** The five subgroups are non-Hispanic white mothers, non-Hispanic black mothers, Mexican or Mexican-American mothers, other Hispanic mothers, and other race or multiracial mothers (Appendix Table F.1).
- **The trimester at study entry:** The three subgroups are first trimester entry, second trimester entry, and third trimester entry (Appendix Table F.2).
- **Smoking status in the three months prior to pregnancy:** The two subgroups are mothers who smoked during this time and mothers who didn’t smoke during this time (Appendix Table F.3).
- **Maternal age at enrollment:** The two subgroups are younger mothers (20 years and younger) and older mothers (21 years and older) (Appendix Table F.4).

Note that since the literature on health disparities typically compares results for minority group members to those for white individuals, the appendix table on subgroup results by maternal race and ethnicity compares white sample members with each minority group.

As discussed in Chapter 4, the subgroup findings suggest that there is little evidence that home visiting was more effective for any of the subgroups examined. Five out of the fifty-six subgroup comparisons are statistically significant, which is similar to what would be expected by chance if there were no differences across subgroups.¹ In addition, the differences that are statistically significant run counter to expectations.

The tables with full subgroup results are presented below.

¹Since adjustments are not typically done for exploratory findings, the study’s analysis plan did not include an explicit adjustment for the subgroup results. However, applying an adjustment according to Benjamini and Hochberg (1995) indicates that none of the subgroup differences are statistically significant after accounting for the number of comparisons.

Appendix Table F.1

Estimated Effects on Confirmatory Outcomes, by Mother's Race and Ethnicity

Outcome	Non-Hispanic White			Non-Hispanic Black			P-Value for Difference from Non-Hispanic White ^a
	Program Group	Control Group	Difference (Impact)	Program Group	Control Group	Difference (Impact)	
<u>Maternal health in pregnancy (%)</u>							
Any smoking during third trimester	25.6	26.5	-0.9	8.9	8.1	0.8	0.605
<u>Birth outcomes and related care (%)</u>							
Low birth weight (< 2,500 grams)	9.5	11.7	-2.3	17.8	15.6	2.2	0.265
Preterm birth (< 37 weeks)	7.3	9.2	-1.9	15.0	11.8	3.2	0.147
Infant admitted to neonatal intensive care unit (NICU) ^b	10.7	9.7	1.0	11.0	9.2	1.9	0.808
<u>Breastfeeding (%)</u>							
Infant was breastfed at discharge	74.5	76.6	-2.1	67.1	67.5	-0.4	0.771
<u>Infant health care use in the first year</u>							
Any emergency department (ED) visits ^b (%)	51.7	49.0	2.7	60.3	56.5	3.8	0.856
Any nonbirth hospitalizations ^b (%)	5.6	6.8	-1.1	6.2	5.3	0.9	0.464
Average number of well-child office visits ^b	3.9	4.2	-0.4	3.8	3.8	0.0	0.170
Sample size	303	300		436	323		

(continued)

Appendix Table F.1 Effects by Mother's Race and Ethnicity (continued)

Outcome	Mexican or Mexican-American				Other Hispanic			
	Program Group	Control Group	Difference (Impact)	P-Value for Difference from Non-Hispanic White ^a	Program Group	Control Group	Difference (Impact)	P-Value for Difference from Non-Hispanic White ^a
<u>Maternal health in pregnancy (%)</u>								
Any smoking during third trimester	1.3	0.4	0.9	0.557	4.1	1.2	2.9	0.287
<u>Birth outcomes and related care (%)</u>								
Low birth weight (< 2,500 grams)	8.9	8.0	0.9	0.379	9.7	9.7	0.0	0.565
Preterm birth (< 37 weeks)	7.8	6.8	0.9	0.390	10.4	10.6	-0.2	0.677
Infant admitted to NICU ^b	10.1	8.5	1.6	0.867	7.9	12.1	-4.2	0.182
<u>Breastfeeding (%)</u>								
Infant was breastfed at discharge	90.5	92.1	-1.5	0.905	83.2	76.6	6.7	0.183
<u>Infant health care use in the first year</u>								
Any ED visits ^b (%)	47.3	48.2	-0.9	0.524	47.2	51.5	-4.2	0.271
Any nonbirth hospitalizations ^b (%)	6.2	6.2	-0.1	0.711	5.6	9.1	-3.4	0.503
Average number of well-child office visits ^b	3.6	3.2	0.3	0.023	3.6	3.8	-0.2	0.536
Sample size	397	330			278	225		

(continued)

Appendix Table F.1 Effects by Mother's Race and Ethnicity (continued)

Outcome	Other/Multiracial			P-Value for Difference from Non-Hispanic White ^a
	Program Group	Control Group	Difference (Impact)	
<u>Maternal health in pregnancy (%)</u>				
Any smoking during third trimester	13.3	10.8	2.5	0.441
<u>Birth outcomes and related care (%)</u>				
Low birth weight (< 2,500 grams)	14.7	9.4	5.3	0.231
Preterm birth (< 37 weeks)	12.1	7.8	4.4	0.293
Infant admitted to NICU ^b	9.8	6.4	3.4	0.660
<u>Breastfeeding (%)</u>				
Infant was breastfed at discharge	84.2	83.7	0.5	0.758
<u>Infant health care use in the first year</u>				
Any ED visits ^b (%)	46.9	58.0	-11.2	0.120
Any nonbirth hospitalizations ^b (%)	4.2	6.1	-2.0	0.832
Average number of well-child office visits ^b	3.8	3.5	0.3	0.252
Sample size (total = 2,864)	136	136		

(continued)

Appendix Table F.1 Effects by Mother's Race and Ethnicity (continued)

SOURCES: Calculations based on state vital records and Medicaid enrollment and claims data.

NOTES: This table focuses on the tests of differences in impacts across subgroups. These tests provide statistical evidence on whether home visiting had larger effects for some groups than for others.

Program impacts were calculated separately for each subgroup. Estimates were regression-adjusted using generalized least squares, controlling for pre-random assignment characteristics of sample members and using average marginal effects. Pre-random assignment characteristics were group mean centered and interacted with the treatment variable to reduce the potential for bias since the sample was not randomized in equal numbers to the program and control groups.

Mothers are categorized as non-Hispanic white, non-Hispanic black, Mexican or Mexican American, or other Hispanic if they self-selected that race/ethnicity on the MIHOPE and MIHOPE-Strong Start baseline surveys. Mothers in the "other/multiracial" subgroup category identified either as another race/ethnicity or as multiracial.

This information is missing for 1.1 percent of mothers in the study, resulting in a sample size of 2,864 for this table.

^aSubgroup difference p-values were estimated with a pairwise test comparing the impact for the race/ethnicity group with the impact for the non-Hispanic white group.

^bThis measure only accounts for health care use paid for by Medicaid.

Appendix Table F.2

Estimated Effects on Confirmatory Outcomes, by Trimester of Enrollment

Outcome	First Trimester			Second Trimester			Third Trimester			Subgroup
	Program Group	Control Group	Difference (Impact)	Program Group	Control Group	Difference (Impact)	Program Group	Control Group	Difference (Impact)	Difference P-Value ^a
<u>Maternal health in pregnancy (%)</u>										
Any smoking during third trimester	9.1	7.5	1.6	10.8	10.2	0.6	7.3	17.1	-9.8	0.020
<u>Birth outcomes and related care (%)</u>										
Low birth weight (< 2,500 grams)	10.3	10.3	-0.1	13.0	12.0	1.0	9.5	13.4	-3.9	0.702
Preterm birth (< 37 weeks)	10.7	9.6	1.2	11.8	9.4	2.4	1.1	12.9	-11.8	0.011
Infant admitted to neonatal intensive care unit (NICU) ^b	8.9	9.3	-0.4	11.2	9.2	2.1	9.0	12.0	-2.9	0.452
<u>Breastfeeding (%)</u>										
Infant was breastfed at discharge	79.8	76.8	3.1	78.8	79.7	-0.8	75.6	67.6	7.9	0.476
<u>Infant health care use in the first year</u>										
Any emergency department (ED) visits ^b (%)	53.3	51.3	1.9	49.7	51.6	-1.9	52.6	60.0	-7.4	0.444
Any nonbirth hospitalizations ^b (%)	4.2	8.1	-3.8	6.4	6.1	0.3	1.7	5.3	-3.5	0.108
Average number of well-child office visits ^b	3.6	3.8	-0.3	3.7	3.6	0.1	3.8	4.2	-0.3	0.187
Sample size (total = 2,896)	597	479		838	741		134	107		

(continued)

Appendix Table F.2 Effects by Trimester of Enrollment (continued)

SOURCES: Calculations based on state vital records and Medicaid enrollment and claims data.

NOTES: This table focuses on the tests of differences in impacts across subgroups. These tests provide statistical evidence on whether home visiting had larger effects for some groups than for others.

Program impacts were calculated separately for each subgroup. Estimates were regression-adjusted using generalized least squares, controlling for pre-random assignment characteristics of sample members and using average marginal effects. Pre-random assignment characteristics were group mean centered and interacted with the treatment variable to reduce the potential for bias since the sample was not randomized in equal numbers to the program and control groups.

Gestational age at the time of random assignment was calculated by subtracting the date of random assignment from the obstetric estimate of gestation at birth from the birth records. If birth records were not available (10.1 percent of the sample), gestational age was calculated by subtracting the date of random assignment from the estimated date of delivery reported by the mother at intake.

First trimester is defined as 13 gestational weeks or less, second trimester is defined as 14 to 27 gestational weeks, and third trimester is defined as 28 gestational weeks or more.

^aSubgroup difference p-values were calculated with an omnibus test (HT statistic), which tests whether the impacts are statistically significantly different across all groups.

^bThis measure only accounts for health care use paid for by Medicaid.

Appendix Table F.3

Estimated Effects on Confirmatory Outcomes, by Smoking Status in Three Months Prior to Pregnancy

Outcome	Smoking			Not Smoking			Subgroup
	Program Group	Control Group	Difference (Impact)	Program Group	Control Group	Difference (Impact)	Difference P-Value ^a
<u>Maternal health in pregnancy (%)</u>							
Any smoking during third trimester	63.7	62.2	1.6	0.1	0.3	-0.2	0.757
<u>Birth outcomes and related care (%)</u>							
Low birth weight (< 2,500 grams)	16.7	14.0	2.7	11.0	11.0	0.0	0.434
Preterm birth (< 37 weeks)	15.9	8.4	7.6	9.8	9.4	0.5	0.052
Infant admitted to neonatal intensive care unit (NICU) ^b	14.8	6.8	8.0	9.6	9.4	0.2	0.026
<u>Breastfeeding (%)</u>							
Infant was breastfed at discharge	72.2	71.9	0.3	80.3	79.3	1.0	0.901
<u>Infant health care use in the first year</u>							
Any emergency department (ED) visits ^b (%)	54.9	54.1	0.8	50.5	51.4	-0.9	0.763
Any nonbirth hospitalizations ^b (%)	8.3	6.9	1.4	4.9	6.7	-1.9	0.315
Average number of well-child office visits ^b	3.8	4.1	-0.3	3.6	3.6	0.0	0.286
Sample size (total = 2,754)	249	217		1,235	1,053		

(continued)

Appendix Table F.3 Effects by Smoking Status (continued)

SOURCES: Calculations based on state vital records and Medicaid enrollment and claims data.

NOTES: This table focuses on the tests of differences in impacts across subgroups. These tests provide statistical evidence on whether home visiting had larger effects for some groups than for others.

Program impacts were calculated separately for each subgroup. Estimates were regression-adjusted using generalized least squares, controlling for pre-random assignment characteristics of sample members and using average marginal effects. Pre-random assignment characteristics were group mean centered and interacted with the treatment variable to reduce the potential for bias since the sample was not randomized in equal numbers to the program and control groups.

Smoking status in the three months prior to pregnancy was derived from state birth records and the MIHOPE family baseline survey. This information is missing for 9.9 percent of mothers in the study, resulting in a sample size of 2,754 for this table.

^aSubgroup difference p-values were calculated with an omnibus test (HT statistic), which tests whether the impacts are statistically significantly different across all groups.

^bThis measure only accounts for health care use paid for by Medicaid.

Appendix Table F.4

Estimated Effects on Confirmatory Outcomes, by Maternal Age at Enrollment

Outcome	Under Age 21			Age 21 or Older			Subgroup
	Program Group	Control Group	Difference (Impact)	Program Group	Control Group	Difference (Impact)	Difference P-Value ^a
<u>Maternal health in pregnancy (%)</u>							
Any smoking during third trimester	7.4	6.2	1.1	11.8	13.0	-1.3	0.167
<u>Birth outcomes and related care (%)</u>							
Low birth weight (< 2,500 grams)	11.2	11.8	-0.6	11.6	12.1	-0.4	0.953
Preterm birth (< 37 weeks)	9.2	9.0	0.2	11.5	10.3	1.2	0.688
Infant admitted to neonatal intensive care unit (NICU) ^b	7.4	7.3	0.1	12.4	11.4	1.0	0.679
<u>Breastfeeding (%)</u>							
Infant was breastfed at discharge	77.9	76.9	1.0	79.8	79.5	0.3	0.845
<u>Infant health care use in the first year</u>							
Any emergency department visits ^b (%)	55.1	56.1	-1.0	47.2	48.9	-1.7	0.847
Any nonbirth hospitalizations ^b (%)	5.0	7.3	-2.3	5.8	6.1	-0.3	0.286
Average number of well-child office visits ^b	3.7	3.7	0.0	3.7	3.8	-0.1	0.559
Sample size (total = 2,896)	738	628		831	699		

(continued)

Appendix Table F.4 Effects by Maternal Age (continued)

SOURCES: Calculations based on state vital records and Medicaid enrollment and claims data.

NOTES: This table focuses on the tests of differences in impacts across subgroups. These tests provide statistical evidence on whether home visiting had larger effects for some groups than for others.

Program impacts were calculated separately for each subgroup. Estimates were regression-adjusted using generalized least squares, controlling for pre-random assignment characteristics of sample members and using average marginal effects. Pre-random assignment characteristics were group mean centered and interacted with the treatment variable to reduce the potential for bias since the sample was not randomized in equal numbers to the program and control groups.

The age of the mother is based on her date of birth, reported at study intake. In a handful of cases, baseline survey data were substituted where the random assignment data seemed inaccurate after comparing that date of birth with vital records data or Medicaid data.

^aSubgroup difference p-values were calculated with an omnibus test (HT statistic), which tests whether the impacts are statistically significantly different across all groups.

^bThis measure only accounts for health care use paid for by Medicaid.

Appendix G

Analysis of Impact Variation

While the main impact analysis presented in Chapter 4, “Estimated Impacts on Prenatal Health, Birth Outcomes, and Health Care Use in the First Year,” showed the effects of the programs as a whole, it is possible that some local programs produced larger or smaller effects than average. By including more than 60 local programs from around the country, the Mother and Infant Home Visiting Program Evaluation-Strong Start (MIHOPE-Strong Start) provides an opportunity to investigate this issue. This chapter includes details on analyses that tied together information on family outcomes with information on local program implementation to investigate how much impacts vary across local programs, whether the characteristics of local programs are associated with larger or smaller effects, and how the services that families received are associated with program effects.

The goal of MIHOPE-Strong Start was to address three broad questions regarding impact variation:

- How much variation is there in impacts across local home visiting programs?
- What is the relationship between the features of local home visiting programs and their effects on family outcomes?
- What is the relationship between the actual home visiting services that families receive and family outcomes?

Since the results of this analysis were only briefly described in Chapter 4, this appendix provides more details — including some technical details — on how these questions were investigated.

Variation in Impacts Across Local Home Visiting Programs

The first issue addressed in this analysis is whether and how much the impacts of home visiting vary across local programs. In conducting this assessment, it is important to distinguish between estimated impacts and true impacts. The estimated effects of home visiting can vary across local programs because some programs are more effective than others or because some programs are located in local communities where home visiting is more or less likely to have an effect. However, estimates can also vary because they are based on a particular group of families, where the estimates would have been different if the study had been conducted with a different group of families at a different point in time. Other factors such as error in measuring outcomes can also contribute to a variation in estimates that does not reflect a true variation in program effectiveness.

To estimate the amount of variation in impacts across local programs, the study team used a random effects framework with no explanatory variables. This framework is expressed in equations (1a) and (1b):

$$Y_{ij} = \alpha_j + \beta X_i + \delta_j T_{ij} + u_{ij}. \quad (1a)$$

$$\delta_j = \delta_0 + \varepsilon_j \quad (1b)$$

In equation (1a), Y_{ij} represents an outcome for family i recruited through local program j . Control group levels vary by local program (α_j), as do impacts (δ_j). The estimation method assumed that α_j is a fixed effect and δ_j is a random effect that is distributed normally with mean δ_0 and variance of τ_1^2 . The model was estimated in Stata version 14.2 using the *mixed* statement. Although seven of the eight confirmatory outcomes are binary, results come from a linear regression because the main impact analysis used linear regression adjustment and because a logistic regression did not converge for all outcomes. As noted in Appendix E, logistic regressions for the main impact analysis produced similar findings to the linear regression adjustment.

Estimates of τ_1 (the standard deviation rather than the variance) are shown in Appendix Table G.1, along with the 90 percent confidence interval of the estimated standard deviation. To provide some context on how much estimates vary across sites, the standard deviation of the estimated effects across sites is presented in the first column of results.

To use the measure of any smoking during the third trimester as an example, the first column shows that the estimated effects have a standard deviation of 7.85 across local programs. Given a typical distribution of impacts, this would suggest that estimated effects range from about -12.9 percentage points to about 12.9 percentage points across 90 percent of the local programs (since the overall estimated effect is close to 0). However, the estimated standard deviation in true impacts is 0 (shown in the second column). In addition, there is little uncertainty in this estimate, as indicated in the 90 percent confidence interval (shown in the last two columns), which ranges from 0.0 to 0.0. The main conclusion that can be drawn from this result is that the variation in estimated effects across local programs is consistent with there being no variation in true impacts. The remainder of Appendix Table G.1 shows that the estimated standard deviation of true impacts is 0 for the other seven confirmatory outcomes, suggesting there is no variation across local programs in their effectiveness in improving these outcomes.¹

¹Results in Appendix Table G.1 expressed as 0.00 are less than 0.005.

Appendix Table G.1

Cross-Site Variance in Estimated Effects and Estimated Variance in True Effects

Outcome	Standard Deviation of Estimates Across Sites	Estimated Standard Deviation of True Impacts	90% Confidence Interval of Estimated Standard Deviation of True Impacts	
			Lower Bound	Upper Bound
<u>Maternal health in pregnancy (%)</u>				
Any smoking during third trimester	7.85	0.00	0.00	0.00
<u>Birth outcomes and related care (%)</u>				
Low birth weight (< 2,500 grams)	10.42	0.00	0.00	6.41
Preterm birth (< 37 weeks)	9.68	0.00	0.00	5.08
Admitted to neonatal intensive care unit ^a	10.26	0.00	0.00	5.13
<u>Breastfeeding (%)</u>				
Infant was breastfed at hospital discharge	14.78	0.00	0.00	0.00
<u>Infant's health care use in the first year</u>				
Any emergency department visits ^a (%)	15.77	0.00	0.00	7.38
Any nonbirth hospitalizations ^a (%)	9.14	0.00	0.00	3.82
Average number of well-child office visits ^a	1.03	0.00	0.00	0.64
Sample size (total=2,896)				

SOURCES: Calculations based on state vital records and Medicaid claims data.

NOTES: The standard deviation of estimates across sites is the variance in estimated impacts from a regression-adjusted generalized least squares model. The estimated standard deviation of true impacts across sites is from a fixed effect, random slope model. See text for more details.

Estimates were controlled for pre-random assignment characteristics of sample members and weighted to adjust for differing random assignment ratios used in MIHOPE and MIHOPE-Strong Start. Pre-random assignment characteristics were mean centered and interacted with the treatment variable to reduce the potential for bias since the sample was not randomized in equal numbers to the program and control groups.

^aThis measure only accounts for health care use paid for by Medicaid.

How Impacts Are Associated with Program Features

The next stage of the analysis explores how the features of local home visiting programs are related to the impacts of the programs.² Even though the previous section indicated that impacts do not vary significantly across local programs for all of the confirmatory outcomes, it is possible that local programs were adapted to their local environments in a way that would reduce the variation in impacts. Thus, local program features could still be associated with larger or smaller effects. Adjusting for local program characteristics might also reduce the amount of unexplained variation across local programs, which could make it easier to detect differences.

This analysis is a natural extension of equations (1a) and (1b), which allow the impact of the local program to vary with the characteristics of the local program and of the family. These extensions are represented in equations (2a) and (2b), and in equations (3a) and (3b) later in the appendix.

$$Y_{ij} = \alpha_j + \beta X_i + \delta_j T_{ij} + \lambda T_{ij} X_i + u_{ij}. \quad (2a)$$

$$\delta_j = \delta_0 + \gamma LP_j + \varepsilon_j \quad (2b)$$

In equation (2a), outcome levels and impacts are allowed to vary with a vector of family characteristics represented by X_i , where the associated parameters are represented by β for outcome levels and λ for impacts. Impacts are also allowed to vary across local programs after taking into account family characteristics. This is represented by δ_j . Note that the effects of family characteristics — β and λ — are not allowed to vary across local programs.

According to equation (2b), the deviation of δ_j from the overall cross-program average (δ_0) is associated with a vector of local program characteristics (LP_j), which have associated estimated effects represented by γ .

For family characteristics, the analysis included all of the subgroup measures analyzed in Chapter 4: (1) race and ethnicity (non-Hispanic white, non-Hispanic black, Mexican or Mexican-American, other Hispanic, and other race or multiracial); (2) maternal age; (3) trimester of enrollment; and (4) whether the mother reported smoking in the three months prior to being pregnant. In addition, the analysis included the density of primary care physicians (PCPs) in the Primary Care Service Area where the mother lived. The availability of PCPs could influence a family's ability to use health care and take advantage of referrals for health care. Better access to primary care could result either in larger effects from home visiting if it made it easier for program group families

²The ideas discussed in this section are based on the methods used in Bloom, Hill, and Riccio (2003).

to take advantage of health care referrals or in smaller effects if control group families had greater access to services in better-served communities.

For the characteristics of local programs, the analysis included measures that met two criteria: (1) influencing family outcomes and (2) varying substantially across local programs. Because the analysis was conducted at the level of the local programs, the home visitor characteristics included are averages across home visitors in a local program.³

The program characteristics include the following:

- **Evidence-based model:** As discussed in Chapter 1, Healthy Families America (HFA) and the Nurse-Family Partnership (NFP) share many goals and methods, but they also differ in a number of respects, including in how they target families for home visiting services, the frequency and duration of services, and home visitor background. According to what the evidence-based model developers told the study team, NFP also places a higher priority than HFA does on improving several aspects of maternal health, including prenatal health, maternal physical health, and family planning and spacing between births.
- **Number of PCPs per 10,000 families in the local community:** This information was measured at the Primary Care Service Area level, or PCSA level, using master files from the American Medical Association (AMA) compiled by the Health Resources and Services Administration (HRSA) in 2010. Prior research has found that areas with a high supply of PCPs have better birth outcomes, lower infant mortality, lower hospitalization rates, and better health outcomes than other areas.⁴ It is not clear what the implication of this is for MIHOPE-Strong Start. On the one hand, program group members may be better able to take advantage of referrals for health care in areas with a high density of physicians, which would suggest home visiting had a larger effect in those areas. On the other hand, control group members might already be

³The analysis was conducted at the local program level because families were randomized to the program and control groups within each local program, which allowed the effects of home visiting to be estimated for each local program. Although it would be of interest to know whether some home visitors were more effective than others, there is no reliable way to estimate impacts for specific home visitors because control group families were not linked to home visitors.

⁴Shi and Starfield (2001); Shi et al. (2005); Parchman and Culler (1994).

getting a high level of services in such areas, which would limit the ability of home visiting to make a difference.

- **Average years of experience of home visitors:** Home visitors with more experience should theoretically be more effective at delivering services, resulting in larger impacts. Although more experienced home visitors might be assigned more difficult families, it is important to remember that this analysis is based on local program averages. As a result, it investigates whether local programs with more experienced home visitors on average have larger effects than other local programs.
- **Average frequency of supervision occurring within a program:** Impacts were expected to be larger when home visitors received more supervision. To measure the relationship between supervision and impacts, the analysis used a measure of whether a supervisor observed a home visitor during one or more home visits. This measure was chosen in part because observation is considered a more intensive and meaningful measure of supervision than other aspects of supervision. Local programs also vary a reasonable amount in their use of such observations.
- **Average home visitor caseload within a program:** Because home visitors with larger caseloads might have less time to spend with each family, they might be less effective at improving family outcomes. Although caseload varies by evidence-based model, the correlation found in MIHOPE-Strong Start is modest (0.33) and the analysis controlled for evidence-based model in investigating the link between program features and impacts.
- **Having a staff person at the local program who is dedicated to continuous quality improvement (CQI) initiatives:** Local programs that have a staff person dedicated to CQI should theoretically be more likely to undertake these initiatives, which might make them more effective at delivering services.

Appendix Table G.2 presents the estimated effects for each evidence-based model and compares impacts between the two models. Overall, there is little evidence that one model produced better effects for families than the other. For example, the estimates indicate that HFA resulted in a reduction in smoking of 1.48 percentage points compared with an increase of 1.33 percentage points for NFP. The difference between

Appendix Table G.2

Estimated Effects on Confirmatory Outcomes, by Evidence-Based Model

Outcome	Estimated Impact		Difference in Estimated Impacts	P-Value of Difference
	HFA	NFP		
<u>Maternal health in pregnancy (%)</u>				
Any smoking during third trimester	-1.48	1.33	-2.81	0.299
<u>Birth outcomes and related care (%)</u>				
Low birth weight (< 2,500 grams)	1.58	-0.32	1.89	0.791
Preterm birth (< 37 weeks)	1.04	1.67	-0.63	0.319
Admitted to neonatal intensive care unit ^a	1.57	0.55	1.01	0.608
<u>Breastfeeding (%)</u>				
Infant was breastfed at hospital discharge	-2.79	3.29	-6.09	0.152
<u>Infant's health care use in the first year</u>				
Any emergency department visits ^a (%)	-0.15	-0.28	0.12	0.989
Any nonbirth hospitalizations ^a (%)	-1.85	-0.85	-1.00	0.238
Average number of well-child office visits ^a	0.14	-0.16	0.29	0.451
Sample size (total=2,896)	1,024	1,872		

SOURCES: Calculations based on state vital records and Medicaid claims data.

NOTES: HFA = Healthy Families America, NFP = Nurse-Family Partnership.

Estimates were regression-adjusted using a fixed effect, random slope model, controlling for pre-random assignment characteristics of sample members and weighted to adjust for differing random assignment ratios used in MIHOPE and MIHOPE-Strong Start. Pre-random assignment characteristics were mean centered and interacted with the treatment variable to reduce the potential for bias since the sample was not randomized in equal numbers to the program and control groups.

The p-value indicates the likelihood of estimating a difference in impacts of this magnitude or larger if the evidence-based models had the same effects.

^aThis measure only accounts for health care use paid for by Medicaid.

the estimated effects of the two models is not statistically significant, as indicated by the p-value of 0.299 shown in the last column.⁵

⁵The model used for estimation in Appendix Table G.2 includes estimated effects based on the full list of program features listed in the appendix. The differences between estimated impacts presented in Appendix Table G.2 and those presented in Chapter 3 are due to the inclusion of these

Estimates do not show a statistically significant difference between the two evidence-based models for any of the eight outcomes, providing more evidence that impacts did not differ substantially between the two evidence-based models. Even taking into account the general lack of statistically significant differences, the differences that do exist do not consistently favor one model or the other. Four of the estimated impacts represent better outcomes for NFP than for HFA (low birth weight, neonatal intensive care unit [NICU] admission, infant breastfed at discharge, and any emergency department [ED] visits for the infant), while the other four are better for HFA.

Appendix Table G.3 shows the estimated effects of the density of PCPs and the four characteristics of home visitors and local programs.⁶ Each row shows one of the eight confirmatory outcomes. The estimates show how much the impact varies with one unit of each characteristic, described as follows:

- **Density of PCPs:** The results show the estimated difference associated with having an additional PCP for every 10,000 people in the community.
- **Home visitor experience:** The results show the estimated difference associated with the average home visitor in a local program having an additional year of experience providing home visiting services.
- **Home visitor's caseload:** The results show the estimated difference in effect associated with one family being added to the average home visitor's caseload.
- **Supervisor observation of home visits:** This measure ranges from 0 to 100. The results show the estimated change in outcome associated with an additional percentage point of home visitors at a local program having at least one home visit observed.
- **Staff dedicated to CQI:** The results show the estimated difference in effect between local programs having a dedicated staff and not having one.

program features. A comparison of effects between the two evidence-based models provides similar results when the additional program features are excluded from the analysis.

⁶Appendix F presents impacts by family characteristic.

Appendix Table G.3

How Estimated Effects Vary with Community, Home Visitor, and Local Program Characteristics

Outcome	PCPs per 10,000 People		Home Visitor Years of Experience		Home Visitor Caseload Size	
	Association Between Impact and an Additional PCP	P-Value	Association Between Impact and an Additional Year	P-Value	Association Between Impact and an Additional Family	P-Value
<u>Maternal health in pregnancy (%)</u>						
Any smoking during third trimester	0.08	0.556	-0.09	0.628	-0.46	0.012
<u>Birth outcomes and related care (%)</u>						
Low birth weight (< 2,500 grams)	-0.64	0.002	0.46	0.283	-0.36	0.295
Preterm birth (< 37 weeks)	-0.32	0.155	0.05	0.884	0.18	0.617
Admitted to neonatal intensive care unit ^a	-0.02	0.920	0.72	0.052	-0.15	0.576
<u>Breastfeeding (%)</u>						
Infant was breastfed at hospital discharge	-0.24	0.443	0.59	0.211	0.01	0.982
<u>Infant's health care use in the first year</u>						
Any emergency department visits ^a (%)	-0.58	0.028	-0.75	0.121	-0.41	0.508
Any nonbirth hospitalizations ^a (%)	-0.12	0.525	0.15	0.528	-0.24	0.358
Average number of well-child office visits ^a	0.00	0.780	0.04	0.227	-0.04	0.371

(continued)

Appendix Table G.3 How Estimated Effects Vary with Selected Characteristics (continued)

Outcome	Supervisor Observations in Prior Year		Dedicated CQI Staff	
	Association Between Impact and an Additional Observation	P-Value	Association Between Impact and Having a Dedicated CQI Staff	P-Value
<u>Maternal health in pregnancy (%)</u>				
Any smoking during third trimester	2.82	0.222	-2.17	0.103
<u>Birth outcomes and related care (%)</u>				
Low birth weight (< 2,500 grams)	6.57	0.052	0.78	0.781
Preterm birth (< 37 weeks)	1.33	0.684	-0.92	0.680
Admitted to neonatal intensive care unit ^a	3.04	0.355	2.04	0.340
<u>Breastfeeding (%)</u>				
Infant was breastfed at hospital discharge	-4.11	0.350	-0.06	0.987
<u>Infant's health care use in the first year</u>				
Any emergency department visits ^a (%)	4.38	0.301	4.00	0.234
Any nonbirth hospitalizations ^a (%)	6.50	0.006	0.36	0.844
Average number of well-child office visits ^a	0.71	0.116	0.05	0.782
Sample size (total=2,896)				

SOURCES: Calculations based on state vital records; Medicaid claims data; U.S. Census Bureau, 2014 American Community Survey five-year estimates; the MIHOPE program manager baseline survey and the MIHOPE-Strong Start program manager survey; and the MIHOPE home visitor baseline survey and the MIHOPE-Strong Start home visitor survey.

NOTES: PCP = primary care physician, CQI = continuous quality improvement.

Estimates were regression-adjusted using a fixed effect, random slope model, controlling for pre-random assignment characteristics of sample members and weighted to adjust for differing random assignment ratios used in MIHOPE and MIHOPE-Strong Start. Pre-random assignment characteristics were mean centered and interacted with the treatment variable to reduce the potential for bias since the sample was not randomized in equal numbers to the program and control groups.

The p-value indicates the likelihood of estimating an association of this magnitude or larger if the true association were zero.

^aThis measure only accounts for health care use paid for by Medicaid.

Consider the relationship between these local program features and the estimated impacts on whether the mother smoked in the third trimester. The results indicate that an additional PCP per 10,000 people is associated with an increase of 0.08 percentage points in women smoking in the third trimester, although that association is not statistically significant. Among the five program features examined, there is one statistically significant association with smoking: Higher caseloads are associated with a greater reduction in smoking among mothers. This result is contrary to the hypothesized effect. It might indicate that the home visitor caseload reflects the influence of other characteristics that differ across local programs. For example, local programs with lower caseloads might serve a group of families with more risk factors, leading those local programs to have smaller effects. Likewise, local programs with lower caseloads might have less experienced home visitors, which could result in smaller effects. Although the analysis attempted to hold family characteristics and home visitor experience constant, such statistical adjustments are never perfect.

Despite the lack of effects for the full sample shown in Chapter 4, Appendix Table G.3 shows some intriguing results:

- Programs located in areas with a higher density of PCPs had greater reductions in low-birth-weight births than other local programs and are associated with greater reductions in infant ED visits than other local programs.
- By contrast, having supervisors observe home visits is associated with more low-birth-weight births and more nonbirth hospitalizations (two outcomes that might be related to each other). Likewise, local programs with more experienced home visitors had more NICU admissions than other local programs. As previously discussed, this might reflect the influence of other characteristics that differ across local programs. For example, increased observation might be done in local programs serving a group of families at greater risk of poor birth outcomes, and such local programs might also seek to employ a more experienced set of home visitors.

How Home Visiting Services Are Associated with Impacts

Chapter 4 also investigated whether the services families received through home visiting are related to the impacts of home visiting. For this analysis, two types of services were examined:

- **Number of home visits:** For prenatal and birth outcomes, the analyses examined the relationship between home visits received during pregnancy and the impacts on family outcomes. Analyses related to child health care in the year after birth included all home visits received before the child was a year old.
- **Referrals for services available in the community:** One of the ways home visitors try to help families is through referrals to services available in the community. Since maternal mental health could affect all outcomes examined in MIHOPE-Strong Start, the analysis investigated whether referrals for mental health services are associated with larger impacts. In addition, analyses of each confirmatory outcome investigated the link between impacts and outcome-specific referrals: (1) Referrals for prenatal health during pregnancy, to examine impacts on birth outcomes, NICU admission, and smoking during the third trimester. This measure also includes referrals for maternal physical health that occurred during pregnancy. (2) Referrals for breastfeeding, infant feeding, and nutrition (one measure) during pregnancy, to examine impacts on attempted breastfeeding before hospital discharge. (3) Referrals for child preventive care after birth, to examine impacts on the following child health care outcomes: well-child visits, ED visits, and hospital admissions.

A concern about investigating the link between services and impacts is that service receipt may vary with family outcomes even if the services do not cause those outcomes to be larger or smaller. Mothers who participate have to agree to schedule visits, to let the home visitor inside their home, and to spend time with the home visitor. It is likely that mothers who benefit the most from home visits will be those who are most engaged in the program and consequently remain enrolled in the program over a longer period of time. Larger impacts for such mothers would not necessarily mean that increasing the number or length of home visits for other mothers would lead to similar improvements in their families' outcomes. It is also possible that mothers who can schedule and keep multiple appointments with a home visitor may have better parenting skills, be better able to navigate the health care system, and be more likely to delay having their next child than other parents. Such parents might not actually benefit much from the program, and impacts might be smaller for them than for other mothers.

To attempt to estimate a causal relationship between home visiting services and impacts, MIHOPE-Strong Start used the method of instrumental variables. In MIHOPE-Strong Start, this method is based on examining the relationship between local program

impacts and the average level of home visiting services received by families in that local program. By focusing on local program averages rather than individual families, the method is intended to reduce the contribution of spurious correlations between outcomes and service levels for individual families.⁷

In notation, the instrumental variable analysis is represented by the following equations:

$$Y_{ij} = \alpha_j + \beta_{1j}X_{ij} + \phi_jM_{ij} + e_{ij} \quad (3a)$$

$$M_{ij} = \mu_j + \beta_{2j}X_{ij} + \delta_jT_{ij} + u_{ij} \quad (3b)$$

In these equations, M_{ij} represents the home visiting services family i received through local program j . The potential problem with equation (3a) is that service receipt might be related to outcomes through unobserved information represented by e_{ij} (for example, maternal motivation, as discussed above). Since random assignment is independent of all information that existed prior to randomization, it would be independent of characteristics such as motivation, intelligence, and other factors that might affect a family's outcomes.

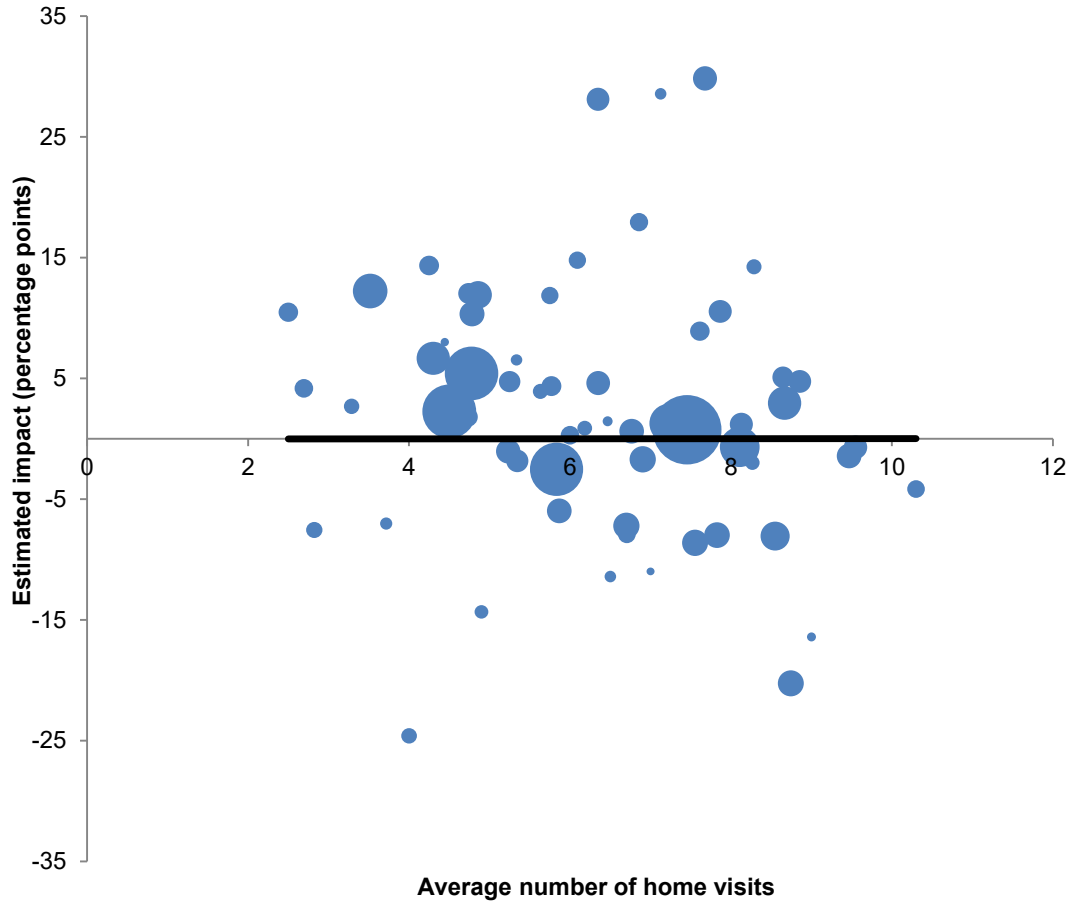
The idea behind this analysis is that local programs that resulted in a greater number of home visits and more referrals should be those where impacts are larger, all else being equal.

The idea behind the instrumental variable analysis is illustrated in Appendix Figure G.1, which shows a comparison between the average number of home visits prior to birth for families served by a local program and the estimated effect on low-birth-weight birth for that local program. Each circle represents one local program. The size of the circle is proportional to the precision of the estimated impact — a smaller circle indicates greater precision — and is generally an indicator of the number of families enrolled in the study through a local program.⁸ The horizontal axis measures the average number of home visits, with circles further to the right representing local programs where families received more visits. As the figure shows, the average number of home visits ranges across local programs from about 3 to about 10. The vertical axis represents the estimated effect on low birth weight by local program, with estimates ranging

⁷For a multisite study such as MIHOPE-Strong Start, however, an instrumental variable analysis assumes that the effectiveness of services provided by local programs is not related to the level of services received by the families in those programs. These and other assumptions are discussed in Reardon and Raudenbush (2013).

⁸The measure of precision is the inverse of the square of the standard error of the impact estimate.

Appendix Figure G.1
Effects on Low Birth Weight, by Average Number of Home Visits
Across Local Programs



SOURCES: Calculations based on state vital records and MIHOPE family service log and management information system data on the number of home visits.

NOTES: Estimates were regression-adjusted using generalized least squares, controlling for pre-random assignment characteristics of sample members and weighted to adjust for differing random assignment ratios used in MIHOPE and MIHOPE-Strong Start. Pre-random assignment characteristics were mean centered and interacted with the treatment variable to reduce the potential for bias since the sample was not randomized in equal numbers to the program and control groups.

The area of a circle is proportional to the inverse of the variance of the estimated impact on the outcome for that local program. Smaller circles indicate greater precision.

The solid line shows the best-fitting linear relationship between the average number of home visits and the estimated impact, by local program.

from a reduction in low-birth-weight births of about 25 percentage points to an increase of about 30 percentage points.⁹

The solid line that appears to lie on the horizontal axis in Appendix Figure G.1 shows the best-fitting linear relationship between the average number of home visits and the estimated impact.¹⁰ The line lies close to the horizontal axis and has very little slope. This suggests that the effect on low birth weight is close to zero for both local programs where program group families received fewer home visits and local programs where program group families received more home visits.

Appendix Table G.4 presents the relationships between the average services provided by a local program — the average number of home visits and the percentage of families who received referrals — and the estimated impact for the local program. The second column shows the estimated change in impact associated with an extra home visit, while the third and fourth columns show the estimated change in impact associated with an average one percentage point increase in the two types of referrals.

Looking at smoking during the third trimester, the first column indicates that an additional home visit reduced the percentage of women who smoked by 0.06 percentage points, but this estimate is not statistically significant (the p-value is 0.499). A referral for outcome-specific services (in this case, for prenatal health care during pregnancy) is associated with an increase in smoking of 1.01 percentage points, but this estimate is also not statistically significant (p-value of 0.369). A referral for mental health services

⁹In MIHOPE-Strong Start, no information was available on service receipt by control group members. However, as discussed in Chapter 2, the study team in MIHOPE-Strong Start sought to recruit local programs that were located in an environment without other comparable services. For recruitment in MIHOPE, the study sought to include all of the local programs providing evidence-based home visiting services from the four models in the study (which, in addition to HFA and NFP, included Early Head Start -- Home-based option and Parents as Teachers). Similarly, for MIHOPE-Strong Start, the team tried to identify and include all programs in the area that were providing services through HFA or NFP. Although MIHOPE-Strong Start did not collect information directly from control group families about their use of other services, MIHOPE did collect information on service use among control group families to shed light on the issue of service contrast. In MIHOPE, about 20 percent of women who were assigned to the control group indicated that they received home visiting or parenting services in the year before completing a follow-up survey, which was conducted around the time the child was 15 months old. Additionally, 9 percent of control group families in MIHOPE received behavioral health services, about 3 percent received intimate partner violence services, and about 4 percent of children received early intervention services.

¹⁰The trend line is based on a weighted linear regression, with local programs weighted by the inverse of the variance of the estimated impact.

Appendix Table G.4

Instrumental Variable Estimates of Effects of Home Visiting Services

Outcome	Number of Home Visits	Any Referral for Outcome- Specific Services	Any Referral for Mental Health Services
<u>Maternal health in pregnancy (%)</u>			
Any smoking during third trimester	-0.06	1.01	-0.57
P-value	(0.499)	(0.369)	(0.875)
<u>Birth outcomes and related care (%)</u>			
Low birth weight (< 2,500 grams)	-0.09	0.59	2.04
P-value	(0.740)	(0.881)	(0.686)
Preterm birth (< 37 weeks)	0.28	-4.01	8.02
P-value	(0.262)	(0.336)	(0.141)
Admitted to neonatal intensive care unit ^a	0.16	-3.07	4.85
P-value	(0.483)	(0.397)	(0.277)
<u>Breastfeeding (%)</u>			
Infant was breastfed at hospital discharge	-0.19	6.29	8.00
P-value	(0.685)	(0.145)	(0.627)
<u>Infant's health care use in the first year</u>			
Any emergency department visits ^a (%)	0.14	6.24	-27.66
P-value	(0.526)	(0.618)	(0.196)
Any nonbirth hospitalizations ^a (%)	0.01	0.30	-1.94
P-value	(0.691)	(0.865)	(0.500)
Average number of well-child office visits ^a	0.01	0.01	-1.14
P-value	(0.284)	(0.991)	(0.272)
Sample size (total=2,896)			

SOURCES: Calculations based on state vital records, Medicaid claims data, and MIHOPE family service log and management information system data on the number of home visits and referrals families received.

NOTES: Estimates were regression-adjusted using an instrumental variable framework, controlling for pre-random assignment characteristics of sample members and weighted to adjust for differing random assignment ratios used in MIHOPE and MIHOPE-Strong Start. Pre-random assignment characteristics were mean centered.

The p-value indicates the likelihood of estimating an impact of this magnitude or larger if the true effect is zero.

^aThis measure only accounts for health care use paid for by Medicaid.

Is associated with a decrease in smoking of 0.57 percentage points, but this estimate is not statistically significant either (p-value of 0.875).

In general, there is little evidence that local programs that provided more home visits or more referrals had larger impacts. Of the 24 estimates presented in Appendix Table G.4, none are statistically significant at the 10 percent level. It is also consistent with the general finding that impacts did not vary across local programs or by local program characteristics.¹¹

¹¹The study team also investigated whether the effects of home visiting services varied with local program features or with the mother's gestational age at study entry. The former was intended to allow the effects of services to vary with the quality of the local program. The latter was intended to allow the effects of home visiting services to be greater for families who entered the study earlier. Neither set of estimates substantially changed the results presented in Table G.4.

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