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Medicaid home visitation and maternal and infant care and health: A reassessment of program effectiveness

Cristian Meghea
Michigan State University

Zhiying You

Jennifer E. Raffo

Lee Anne Roman

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Cover Page Footnote

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INTRODUCTION

Medicaid supports state sponsored, home visiting programs to improve maternal and child care and health outcomes. A majority of states in the United States have home visiting programs which target Medicaid-insured pregnant women and their infants to provide care coordination, health education, and referrals for addressing social determinants of health and providing psychosocial support (Henry J. Kaiser Family Foundation, 2011; C. Johnson & Witgert, 2010; K. Johnson, 2009; Witgert, Giles, & Richardson, 2012). These programs serve low-income women who have relatively greater environmental stressors (Cook et al., 2010; Gavin, Nurius, & Logan-Greene, 2012; Holzman et al., 2006), more health and social problems (Cook et al., 2010; Giurgescu et al., 2012; Roman et al., 2010), and who are also at higher risk of preterm birth, low birth weight birth, and infant death (Blumenshine, Egerter, Barclay, Cubbin, & Braveman, 2010; Brintnell, Peterson-Hickey, Stroud, Castellano, & Fogarty, 2005).

The effectiveness of population-based home visiting programs in improving care and health outcomes is difficult to evaluate. One major reason is that randomized controlled trials are not feasible when such programs offer population-wide eligibility. Quasi-experimental evaluations of population-based statewide or regional programs with large sample sizes are few (Meghea, Raffo, Zhu, & Roman, 2013; Meghea, You, Raffo, Leach, & Roman, 2015; Roman, Raffo, Zhu, & Meghea, 2014; Vaithianathan, Wilson, Maloney, & Baird, 2016), generally used linked administrative data and relied on propensity score matching at the individual level as the evaluation methodology, and found some positive program effects on maternal and infant care (Meghea et al., 2013; Vaithianathan et al., 2016), birth outcomes (Roman et al., 2014) and health outcomes, including infant mortality (Meghea et al., 2015; Vaithianathan et al., 2016). One of the main limitations of propensity score matched program evaluations is the relatively small number of matching characteristics observed for both program participants and non-participants, which allows for the possibility of hidden bias due to unobserved variables. Generally, home visiting programs screen participants on a comprehensive set of characteristics and prenatal risks. Some of the screened participants do not receive any post-screening service, representing a group of virtually non-participants in the programs with a significant number of observed variables available for program evaluation analyses.

Maternal Infant Health Program (MIHP) is Michigan's largest home visiting program. Propensity score matched evaluations showed that MIHP was effective in improving maternal and infant care and health outcomes (Meghea et al., 2013; Meghea et al., 2015; Roman et al., 2014). All Medicaid eligible pregnant women and newborns in Michigan qualify for MIHP. Fewer than one third of the Medicaid eligible pregnant women are screened into MIHP. Pregnant women are

screened on a comprehensive set of risk factors at prenatal program enrollment. Among those screened during pregnancy, some do not receive any additional MIHP services, presenting the opportunity of comparing this subgroup of virtually nonparticipants to those who receive additional prenatal services, including home visiting, to evaluate the effectiveness of the program. Those who receive additional program services outnumbered those screened-only by a factor of more than four. As a result, a matching approach comparing those with additional services to those screened-only (virtually nonparticipants) was impractical. As a feasible alternative, this study compared MIHP participants who were screened during pregnancy and received additional prenatal MIHP services to those screened-only, adjusting for a comprehensive set of characteristics and risk factors. As with the prior MIHP evaluations (Meghea et al., 2013; Meghea et al., 2015; Roman et al., 2014), this study also accounted for program timing and dosage, important considerations when evaluating home visiting programs.

The purpose of the study was to further explore the effectiveness of MIHP, a Medicaid population-based home visiting program, using a strategy to mitigate the possibility of selection bias due to characteristics unobserved in previous propensity score matched evaluations (Meghea et al., 2013; Meghea et al., 2015; Roman et al., 2014). This study complements the MIHP matched comparison analyses (Meghea et al., 2013; Meghea et al., 2015; Roman et al., 2014) by accounting for the previously unexamined participant – nonparticipant differences in individual characteristics and risk factors screened at the MIHP prenatal enrollment.

METHODS

Study design

This retrospective study used propensity score adjustment regression methods to compare the maternal and child health care use and health outcomes of those screened into prenatal MIHP who received additional services and those screened-only. The study was exempt from IRB approval by the Michigan State University IRB because it was considered research not involving human subjects due to the use of retrospective de-identified data.

Study population and data sources

The study population is represented by all women who were screened in MIHP during pregnancy and delivered a singleton birth in Michigan 1/1/2009 – 12/31/2012 (N=69,408). Infants and mothers were linked based on unique Michigan Department of Health and Human Services (MDHHS) master record

numbers. All data were available through the data warehouse from MDHHS. Data were assembled and analyzed between 2014-2016.

The linked data for this population of mothers and infants consisted of the MIHP prenatal screening data, all Medicaid maternal medical claims during pregnancy and 12 months postpartum, monthly Medicaid eligibility from 3 months prior to conception through the first 12 months postpartum, other program participation (such as cash assistance) linked to infant birth records (including maternal demographics and reproductive history), infant death records, and monthly infant Medicaid eligibility and infant medical claims for the first 12 months of life.

Outcomes

Outcomes were defined based on administrative data. Adequacy of prenatal care was determined by the Adequacy of Prenatal Care Utilization Kotelchuck Index (Inadequate, Intermediate, Adequate, or Adequate Plus) reported on the birth certificate (Kotelchuck, 1994). As women receiving Adequate Plus care tend to be medically high risk, women who received Adequate Plus care were excluded in the first binary outcome coded 1 if the Kotelchuck Index was "adequate" and 0 if it was "intermediate or inadequate". The second adequacy of prenatal care definition, consistent with state and federal reporting (Michigan Department of Community Health) was coded 1 if the Kotelchuck Index was "adequate or adequate plus" and 0 if it was "intermediate or inadequate."

The presence of prenatal care (binary) was coded 1 if there was any prenatal care and 0 otherwise. Qualifying current procedural terminology (CPT) and ICD-9 codes on maternal Medicaid claims with a date of service between 21 and 56 days after delivery were used to determine the presence of a postpartum visit (Reed DE, Ramsini W, & Hughes KF, 2007). The postpartum visit variable (binary) was coded as 1 if the mother had any qualifying postpartum visits and 0 otherwise. Women who lose Medicaid after they give birth become eligible for family planning coverage. The outcome was binary coded as 1 for women who enrolled in Plan First!, a state-funded family planning health plan, in the first 12 months postpartum and 0 otherwise.

CPT codes on infant Medicaid claims were used to identify well-child visits during the first year of life. An indicator for "any well-child visits" was coded 1 if the infant had any such visits and 0 otherwise. Further, a binary indicator was coded 1 if the infant had at least seven well-child visits in the first year of life and 0 otherwise per recommended by American Academy of Pediatrics.

Birth outcomes, defined as binary indicators, included low birth weight (LBW), defined as less than 2500 g reported on the birth certificate; preterm birth, described as delivery before 37 completed weeks' gestation based on the last

menstrual period self-reported on the birth certificate; very low birth weight (VLBW), defined as less than 1500 g reported on the birth certificate; and very preterm birth, defined as delivery before 32 completed weeks' gestation. The infant mortality was coded binary, 1 if the newborn birth certificate was linked to a death certificate in the state of Michigan with a death date in the first year of life, and 0 otherwise.

The analyses of maternal outcomes, except Plan First!, included all women, because all retain Medicaid eligibility and MIHP (if participating) throughout pregnancy and for at least 60 days postpartum. The Plan First! outcome was analyzed for women who lost Medicaid eligibility postpartum. Infant well-child visits, derived from Medicaid claims, were analyzed for the infants who retained Medicaid eligibility for the entire 12 months postpartum in order to observe the outcomes consistently for the entire analytic sample.

MIHP participation

Although all women in the analyzed population were screened into MIHP during pregnancy, the women screened-only who received no other MIHP services during pregnancy were considered nonparticipants for the purposes of this study. Those screened who received additional MIHP services were considered MIHP participants. A binary MIHP participation was defined 1 for those screened who received additional MIHP services and 0 for those screened-only. To account for the dosage of MIHP services and the timing of enrolment into MIHP, a second MIHP participation was defined 1 if women were screened into MIHP in the 1st or 2^{nd} pregnancy trimester and had at least three additional MIHP face to face contacts during pregnancy and 0 if screened-only.

Baseline covariates used for propensity score adjustment

Maternal age, marital status, race/ethnicity, smoking status during pregnancy, first-time pregnancy, and prior repeat pregnancy within 18 months were assessed. Two SES measures were also included. The first (yes/no) identified pregnant women with income at $\leq$33% of the federal poverty level (FPL) based on their participation in the Low-Income Family Program and receipt of cash assistance.

The second indicator distinguished between: (1) Medicaid-eligible pregnant women who had Medicaid before pregnancy (qualifying income ≤63% FPL if aged >19 years, the majority in this study; and ≤ 150% FPL if aged ≤19 years); and (2) higher-income women who became eligible after confirming the pregnancy, with qualifying income of ≤185% FPL regardless of age (Henry J. Kaiser Family Foundation, 2011). The baseline characteristics also included three binary indicators for maternal chronic conditions not specific to pregnancy. The presence of related claims during pregnancy, based on diagnostics and procedure codes was considered evidence of maternal chronic disease. To minimize the likelihood of measurement error, including the potential for disease onset after MIHP enrollment during pregnancy, some of the most prevalent conditions were selected: asthma (including chronic bronchitis and emphysema); diabetes; and hypertension.

In addition to the above characteristics, available for all women regardless of their enrollment in MIHP, the prenatal MIHP screening data allowed further adjustments along a variety of maternal characteristics and pregnancy risks only measured for those screened in the program. These included maternal education, work status, self-reported history of chronic disease, prior pregnancy complications, whether the pregnancy was planned, obesity, drug use, stress, depressive symptoms, history of mental health concerns, history of abuse, and unaddressed basic needs.

Statistical analyses

Descriptive statistics (Table 1) were presented to summarize the distribution of the independent variables for those screened who received additional MIHP services and those screened-only. To assess the effect of MIHP participation on the analyzed outcomes, propensity score adjusted regressions were used to control for the potential selection bias induced by the observed differences in the baseline covariates.

We present odds ratios (OR) for the effect of MIHP participation on binary outcomes analyzed through propensity score adjusted logistic regressions (Table 2). SAS, version 9.1.3 was used to perform the analyses between 2014-2016.

Table 1. Baseline comparisons: MIHP screened-only vs. MIHP screened plus services, singleton births 1/1/2009 – 12/31/2012

	Screened plus services (N=54743)		**Screened-only (N=14665)**		**P value**
	N	**(%)**	**N**	**(%)**	
Mother race category					<.01
White	29979	54.8	8721	59.5	
Black	21021	38.4	4854	33.1	
American Indian	364	0.7	97	0.7	
Other	3379	6.2	993	6.8	
Mother age group					<.01
<20	11156	20.4	2251	15.3	
20-29	34357	62.8	9638	65.7	
30-39	8616	15.7	2611	17.8	
>=40	614	1.1	165	1.1	
Unmarried	41697	76.2	10531	71.8	<.01
Smoked during pregnancy	17878	32.7	4858	33.1	<.01
Prior pregnancy < 18 months					0.28
<18 months	13255	24.2	3868	26.4	
>=18 months	17987	32.9	5366	36.6	
No prior deliveries	21191	38.7	4769	32.5	
Unknown	2310	4.2	662	4.5	
Income <= 33% of FPL	16726	30.6	3647	24.9	<.01
Medicaid before conception	32741	59.8	7814	53.3	<.01
Asthma	1923	3.5	345	2.4	<.01
Diabetes	1889	3.5	357	2.4	<.01
Hypertension	1368	2.5	308	2.1	<.01
Education <12 years	15539	28.4	2903	19.8	<.01
Work outside home	16385	29.9	4042	27.6	<.01
Chronic disease	20798	38.0	4067	27.7	<.01
Prior pregnancy complications	8892	16.2	1911	13.0	<.01
This was an unplanned pregnancy	33998	62.1	6654	45.4	<.01
Obese	15301	28.0	2910	19.8	<.01
Drug user	7361	13.4	1319	9.0	<.01
Stress = high	21593	39.4	3594	24.5	<.01
Depressive symptoms = moderate-severe	8925	16.3	1366	9.3	<.01
History of mental concerns	17742	32.4	3512	23.9	<.01
Abuse	17544	32.0	2882	19.7	<.01
Basic needs not addressed (housing, food)	32197	58.8	5870	40.0	<.01
	Mean	**std**	**Mean**	**Std**	
Mother age (mean)	24.2	5.5	24.8	5.4	<.01

Note: P value was based on the Chi-square test of two groups, except for mother age, which was based on the two-sample t-test.

Table 2. Propensity score adjusted multivariate regressions: MIHP screened plus services vs MIHP screened-only, singleton births 1/1/2009 – 12/31/2012

Outcomes	**MIHP screened plus services vs MIHP screened-only**	**MIHP screened plus ≥ 3 service visits vs MIHP screened-only**
Maternal and infant care		
Any prenatal care	2.06 (1.67, 2.54)	2.52 (1.99, 3.19)
Adequate prenatal care (Adequate vs Intermediate/Inadequate)	1.12 (1.07, 1.18)	1.24 (1.18, 1.30)
Adequate prenatal care (Adequate/Adequate-Plus vs Intermediate/Inadequate)	1.11 (1.05, 1.16)	1.21 (1.15, 1.28)
Appropriate postnatal visit	1.27 (1.22, 1.32)	1.30 (1.25, 1.36)
Enrolled in postnatal Plan First! family planning	1.19 (1.00, 1.41)	1.23 (1.03, 1.48)
Any infant well-child visits 1st year	1.45 (1.30, 1.61)	1.58 (1.41, 1.78)
Appropriate number of well-child visits 1st year	1.30 (1.24, 1.36)	1.36 (1.30, 1.43)
Maternal and infant health		
Birth weight (grams)	22.99 (11.60,34.37)	18.85 (6.80, 30.91)
Gestational age at birth (completed weeks)	0.16 (0.11,0.21)	0.07 (0.01, 0.13)
Low birth weight	0.84 (0.78,0.90)	0.86 (0.79, 0.2)
Very low birth weight	0.63 (0.53,0.75)	0.64 (0.53, 0.77)
Preterm birth	0.83 (0.78,0.88)	0.89 (0.83, 0.95)
Very preterm birth	0.67 (0.58,0.77)	0.73 (0.63, 0.85)
Infant death 1st year of life	0.84 (0.64,1.11)	0.85 (0.63, 1.14)

Note. The regressions adjusted for all covariates reported in Table 1. Linear regression models were used in the analysis of birth weight and pregnancy weeks. Logistic regressions were used for all other outcomes (binary).

RESULTS

There were significant differences between the women screened into MIHP who received additional MIHP services and those who were screened-only (Table 1). Compared to those screened-only, women who received additional MIHP services were more likely to be Black (38.4% vs 33.1%), be unmarried (76.2% vs 71.8%), be a first-time mother (38.7% vs 32.5%), receive cash assistance (<33% FPL: 30.6% vs 24.9%), and to be continuously on Medicaid (59.8% vs 53.3%). Based on the MIHP screening assessment, women who received additional MIHP services were more likely to have less than high school education (28.4% vs 19.8%), work outside their home (29.9% vs 27.6%), have chronic disease (38.0% vs 27.7%), have prior pregnancy complications (16.2% vs 13.0%), not have planned the pregnancy (62.1% vs 45.4%), be obese (28.0% vs. 19.8%), use drugs (13.4% vs 9.0%), have high perceived stress (39.4% vs 24.5%), have moderate-

severe depressive symptoms (16.3% vs 9.3%), have a history of mental health issues (32.4% vs 23.9%), have experienced abuse (32.0% vs 19.7%), and to have unaddressed basic needs (58.8% vs 40.0%).

After accounting for all the above differences in propensity score adjusted regression analyses, the women who received additional MIHP services after screening and their infants had better health care utilization and improved health outcomes compared to those screened-only (Table 2). Specifically, those who received additional MIHP services had higher odds of receiving any prenatal care (OR=2.06, 95% CI [1.67, 2.54]), adequate prenatal care (OR=1.12, 95% CI [1.07, 1.18]), an appropriate postnatal checkup (OR=1.27, 95%CI [1.22, 1.32]), and of enrolling in the Plan First! program offering family planning for women who lost Medicaid eligibility post-birth (OR=1.19, 95% CI [1.00, 1.41]). At birth, the women who received additional MIHP services after screening had improved birth outcomes: increased weight (+23 grams, 95% CI [12, 34]), reduced odds of LBW (OR=0.84, 95% CI [0.78, 0.90]) and very LBW (OR=0.63, 95% CI [0.53, 0.75]), increased gestational age (+0.16 weeks, 95% CI[0.11, 0.21]), reduced odds of prematurity (OR=0.83, [0.78, 0.88]) and extreme prematurity (OR=0.67, 95% CI [0.58, 0.77]). Their infants had increased odds of receiving well-child preventive care visits (OR=1.45, 95% CI [1.30, 1.61]) and of receiving the appropriate number of well-child visits in the first year of life (OR=1.30, 95% CI [1.24, 1.36]).

Compared to women screened-only, those who were screened into MIHP in the 1st or 2nd pregnancy trimester and had 3 or more prenatal MIHP contacts had higher odds of receiving any prenatal care (OR=2.52, 95% CI [1.99, 3.19]), adequate prenatal care (OR=1.24, 95% CI [1.18, 1.30]), an appropriate postnatal checkup (OR=1.30, 95% CI [1.25, 1.36]), and of enrolling in the Plan First! program (OR=1.23, 95% CI [1.03, 1.48]). At birth, those who were screened into MIHP in the 1st or 2nd pregnancy trimester and had 3 or more prenatal MIHP contacts had improved birth outcomes: increased weight (+19 grams CI [7, 31]), reduced LBW (OR=0.86, 95% CI [0.79, 0.92]) and very LBW (OR=0.64, 95% CI [0.53, 0.77]), increased gestational age (+0.07 weeks, 95% CI[0.01, 0.13]), reduced odds of prematurity (OR=0.89, 95% CI[0.83, 0.95]) and extreme prematurity (OR=0.73, 95% CI [0.63, 0.85]). Their infants had increased odds of receiving well-child preventive care visits (OR=1.58, 95% CI [1.41, 1.78]) and of receiving the appropriate number of well-child visits in the first year of life (OR=1.36,95% CI [1.30, 1.43]). (Table 2).

DISCUSSION

Recent reviews of home visiting programs showed mixed findings regarding the effectiveness on improving the care and outcomes of disadvantaged families with

pregnant women and infants (Issel, Forrestal, Slaughter, Wiencrot, & Handler, 2011; Sama-Miller, 2016). Randomized controlled trials are limited by relatively small samples and the inability to establish impacts on rare-event outcomes, and are not easily generalizable in community settings. In addition, trials may not be feasible for programs with population-wide eligibility. The few population-based quasi-experimental evaluations of state or regional programs used propensity score matching and were limited by the availability of risk characteristics for matching, which allows for the possibility of bias induced by unobserved variables.

We took advantage of an opportunity to further explore home visiting outcomes in a state-wide program, MIHP, using a broader set of risk characteristics, comparing women who were risk screened for the program and did not receive additional services with those who received services. Consistent with the positive findings from the propensity score matching MIHP evaluations (Meghea et al., 2013; Meghea et al., 2015; Roman et al., 2014), the results of this study revealed that participants who were screened into MIHP and received additional prenatal services had improved maternal and child health care use and health outcomes during pregnancy, at birth, and sustained after birth compared to those screened-only who received no additional MIHP services.

Similar to prior quasi-experimental matched analyses (Meghea et al., 2013; Meghea et al., 2015; Roman et al., 2014) that found significant differences between MIHP participants and nonparticipants suggesting the possibility of selection bias, this study found differences along the same baseline characteristics between those screened into MIHP during pregnancy who received additional MIHP services and those screened-only (virtually nonparticipants). In addition, differences were observed along an expanded set of program screened risk factors, confirming the need for the program evaluation to account for participant-nonparticipant differences in characteristics and risk factors not observed in prior matched evaluations (Meghea et al., 2013; Meghea et al., 2015; Roman et al., 2014).

Prior RCTs of other home-visitation programs did not find positive effects on the use of prenatal care (Kitzman et al., 1997; Koniak-Griffin et al., 2002). A quasi-experimental propensity score matched MIHP evaluation (Meghea et al., 2013) found that home visiting improved maternal prenatal and postnatal care. The findings of improved infant use of preventive services were similar with RCT (Guyer et al., 2003; Landsverk et al., 2002) and propensity score matched evaluations (Vaithianathan et al., 2016) of other home-visitation programs.

The positive MIHP effects in reducing adverse birth outcomes were consistent with a prior propensity score matching evaluation of the program (Roman et al., 2014) that found reductions in the risk of prematurity and low birth weight and with several RCT evaluations that found that participation in prenatal home

visiting programs increased birth weight (Guyer et al., 2003; Kitzman et al., 1997). The RCTs found no program effect on reducing prematurity. Another study (Landsverk et al., 2002) used propensity score matching in an urban population and found that participation in a federal Healthy Start home visiting program significantly reduced LBW and prematurity. However, the study relied on a very small sample size and limited matching characteristics. A recent study used propensity score matching to evaluate home visiting in Japan and found that, among high-risk pregnant women, women who received the home-visit program had lower odds of preterm birth, delivered at longer gestational ages, and children born to mothers who received the program showed an increase in birth weight (Ichikawa, Fujiwara, & Nakayama, 2015).

The main limitation of this retrospective observational study is the potential risk heterogeneity in the group of women who were screened into the home visiting program and did not receive any additional services. The group included women who were screened and refused to receive further services, women who may have not needed any further services based on the initial screening and assessment, and women who did not engage with the program or were lost to follow up.

CONCLUSIONS

The favorable effects of a statewide home visiting program across a range of maternal and infant care and health outcomes found in this study, after accounting for an expanded set of program-screened risk factors, lend additional support to those previously observed in quasi-experimental propensity score matched evaluations during pregnancy, at birth, and after birth. The findings provide additional evidence to support the effectiveness of population-based home visiting programs in improving the care and health outcomes of families with pregnant women and infants. There is a need for program evaluations using comparison groups to account for a broad range of characteristics and risk factors in order to increase the evaluation's accuracy.

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