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The Potential Economic Impact of a Coordinated Home Visitation Program: Preventing Adverse Birth Outcomes

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Abstract

Background and Purpose Evidence about the efficacy of healthy pregnancy home visitation programs is needed in California's underserved Hispanic population, where preterm birth rates are higher than non-Hispanic Whites. This study describes birth outcome data in a sample of families participating in the MOMS Orange County home visitation program. **Methods**: A descriptive comparative design was used. Birth outcome data for 1,102 women who participated in MOMS Orange County and had a live birth in 2010 were compared with data from the county of Orange (N = 38, 237) and the state of California (N = 509, 979) for the same time period, derived from county and state birth and death reports. Measures included social background, birth outcomes, and potential cost savings. **Results**: Although MOMS program mothers were less educated and had a higher level of poverty compared to both county and state samples, they had significantly fewer preterm births compared with the countywide and statewide samples. It was estimated that the provision of a home visitation program both countywide and statewide would result in a potential cost saving that $1.1 and $ 2.1 million, respectively. **Conclusion**: This coordinated prenatal program may improve birth outcomes among communities of impoverished women at potentially reduced costs.

Keywords: birth outcomes, community-based home visitation, cost savings, health disparities

Introduction

Decreasing preterm infant mortality and morbidity is a public health priority in the U.S. Underserved minority populations face a disproportionately high risk of preterm births (King, Gazmararian, & Shapiro-Mendoza, 2014). Community-based prenatal programs have the potential for decreasing adverse birth outcomes in minority and impoverished populations and have garnered the attention of numerous state and national organizations (Hollowell, Oakley, Kurinczuk, Brocklehurst, & Gray, 2011). This study evaluates a community-based home visitation prenatal program to examine how this intervention impacts birth outcomes in a high-risk, primarily low-income Latino population.

Adverse Birth Outcomes and their Consequences

Healthy birth outcomes impact the well-being of families, including the future healthcare needs of women, infants and children. Decreasing the rates of preterm births and infant deaths remains "among the Nation's most pressing challenges" (Healthy People [HP] 2020). Despite a decline in the infant mortality rate in the U.S., the rate remains higher than 46 other countries and decreasing these numbers across all ethnic and socioeconomic groups is a public health imperative (Jacob, 2016; HP 2020). Two-thirds of infant mortality was caused by complications

from preterm births in the U.S. (Martin et al., 2012). In 2013, the National Center for Health Statistics reported that the U.S. preterm birth rate was 11.4% (HP 2020). A number of factors predict vulnerability to preterm births; these include young maternal age, high school education only and being a single mother, maternal history of being born preterm, maternal diabetes mellitus, maternal stress and depression, substance use, and intimate partner violence (Alhusen et al., 2014; Boivin et al., 2015; Dorfman, Srinath, Rockhill, & Hogue, 2015; Janisse, Bailey, Ager, & Sokol, 2014; Sukhato et al., 2015).

Preterm and low birth weight (LBW) births are also associated with increased risk for adverse child development, including physical and learning disabilities (Spracklen et al., 2016; Squarza et al., 2016). As a result, these infants frequently utilize more healthcare services and social resources, resulting in higher costs than term infants in the U.S. Furthermore, the increased use of medical services for premature or LBW infants results in persistent higher costs throughout their entire lifetime (Institute of Medicine [IOM], Committee on Understanding Premature Birth and Assuring Healthy Outcomes, 2007).

Given that adverse birth outcomes are associated with significant lifelong health care needs and economic burdens on families and our healthcare system, prevention of preterm and LBW birth demands innovative, low-cost interventions for the future well-being of our communities. Nurse-led prenatal home visitation programs have been established as cost-effective preventive interventions because these programs can change modifiable risks and ultimately lead to improvements in birth outcomes, increasing a child's school readiness, and preventing child abuse and neglect (Miller, 2015).

Racial and Ethnic Health Disparities in Birth Outcomes among Underserved Populations

World-wide, health disparities in birth outcomes are associated with large scale social and economic suffering and inequalities. In the U.S., profound health disparities in birth outcomes have been repeatedly linked with the high incidence of poverty and poor access to health care in these communities (Lu et al., 2010). The non-Hispanic Black population has continued to suffer approximately twice the infant mortality rate compared to non-Hispanic Whites (Mattews & MacDorman, 2013). Among Hispanic mothers, infant mortality in a population of Puerto Rican origin (7.10 per 1,000 live births) was higher than that among non-Hispanic white mothers (5.18 per 1000 live birth) (Mathews & MacDorman, 2013). According to a recent census report, the Hispanic population (17.1%) is the fastest growing ethnicity in the U.S., followed by African Americans (13.2%) (U.S. Census Bureau, 2013).

California has the largest Hispanic population in the United States, accounting for one-third of the nation's Hispanic population. California also has the highest number of births in the U.S. (approximately one in every eight births nationally occurs in CA) and more residents living in poverty than the rest of the nation (approximately 12 in 100 residents living in poverty from CA) (Bohn & Levin, 2013; Brown & Lopez, 2013; Martin et al., 2012). In 2008, more than half (57.9%) of pregnant women in California were classified as being at a low socioeconomic level; Hispanic women have the highest poverty rate (81.9%), followed by African-American women (72.7%), White (31.6%) and Asian/Pacific Islander women (28.7%) (California Department of Public Health, 2010b). Important health disparities surrounding maternal and infant health have been documented yearly in California. Preterm birth rates for Hispanic women in CA at 9.0% remain above the rates for non-Hispanic Whites at 7.9%. Infant mortality rates among Hispanics remain higher (5.1/1,000 live births) compared to non-Hispanic Whites (3.8/1,000 live births) (California Department of Public Health, 2013).

Given the rapid growth of the Hispanic population and the ethnic disparities in birth outcomes in California, community-based prenatal programs are necessary to promote healthy pregnancies and birth outcomes targeting this underserved community. Community-based case management has been promoted as a key prevention approach to

reduce negative birth outcomes in high-risk communities (Cramer, Chen, Roberts, & Clute, 2007). Despite the documented need, there is scant rigorous evidence that community-based programs diminish negative birth outcomes in the Hispanic community. This study aims to address this lack of evidence by evaluating the impact of a specific model of community-based home visitation on birth outcomes in Orange County, California.

The Current Study

MOMS Orange County (MOMS) is a community-based home visitation program serving geographic areas with high concentrations of Medi-Cal covered pregnancies and births (California Department of Public Health, 2010b). Among approximately 20,000 low-income families with children under five years old in Orange County, only 1,144 families received services by one of the four national evidence-based home visiting models in Orange County (Nurse Family Partnership, Parents as Teachers, Early Head Start and Parent-Child Home Program) (California Department of Public Health, 2010b; U.S. Census Bureau, 2012). MOMS designed their program to address this profound gap in services to low-income and underserved families.

The mission of MOMS is to promote healthy pregnancies and improve birth outcomes for underserved families. MOMS developed a *coordinated care* model utilizing highly trained paraprofessionals as home visitors supervised by registered nurses (RNs) who function as case managers. Together, this team-based model provides direct services, focused assessments, and education to high-risk pregnant and postpartum women and infants. The monthly home visits serve low-income pregnant women during pregnancy through the infant's first birthday, including assessment of physical and mental health needs and provision of health education. The health education portion of the program is designed to help clients: (a) access prenatal care, (b) become aware of the signs of hypertensive disorders of pregnancy, (c) prepare for child birth, (d) facilitate communication with their healthcare providers, (e) promote nutrition and breastfeeding, and (f) enhance parenting skills. Further, referrals are made to public health nurses, other healthcare providers and community services when needed. The RN case managers provide immediate supervision of the program's home visitors, review assessments for their accuracy, develop client care plans, and coordinate referral resources and services.

Although MOMS has been in operation for over 20 years, rigorous studies evaluating the program's impact on birth outcomes have been mostly absent. The purpose of this study was to describe the relative impact of this coordinated prenatal home visitation program on birth outcomes and potential cost savings. The specific research questions were:

1. What birth outcomes occur in the communities receiving the MOMS program?
2. How are these birth outcomes similar or dissimilar to both county and state comparison groups (Orange County and California State)?
3. What, if any, birth outcome cost savings are potentially associated with the MOMS home visitation program relative to general projections of costs countywide and statewide?

Methods

Study Design

This study employed a descriptive comparative design**.** Analysis of available data known to influence birth outcomes was used to assess the social and economic impact of the MOMS program on birth outcomes as compared with County and State birth data. The University's Institutional Review Board (IRB) approved the study to conduct analyses using a de-identified database provided by MOMS.

Participants

The sample was obtained from individual data of mothers served by the MOMS home visitation program who delivered live births from January to December in 2010 (N = 1,102). Paraprofessionals conducted the home visits and collected prenatal and postnatal data with RNs' supervision. The birth prevalence data of Orange County (N = 38, 237) and California State (N = 509, 979) were obtained from the annual state

statistical reports (California Department of Public Health, 2010a).

Measures

Social Background. MOMS data included demographics, pregnancy history, prenatal and postnatal physical and psychosocial health, nutrition, social support, access to medical care, parenting, and breastfeeding. Of the prenatal and postnatal data, only demographic information and birth outcomes were used for analysis. The data from Orange County and California included demographic information and birth outcomes (California Department of Public Health, 2010a). Social background, birth outcomes, and cost saving factors were included to measure the potential impact of the MOMS program. Socioeconomic background data included maternal age, ethnicity, place of mother's birth, education, prenatal insurance and poverty. Poverty level was calculated as the percentage of the sample falling below the U.S. Department of Health Services thresholds in either of three categories: 0-100%, 101-200% or 201%- and higher.

Birth Outcomes. Birth outcome data included negative birth outcomes and mortality rate. For the MOMS data, paraprofessionals obtained birth data while interviewing mothers. Negative birth outcomes were indicated by low birth weight (live birth < 2,500 g), very low birth weight (live birth < 1,500 g), and preterm births (live birth < 37 weeks). Mortality rate was indicated by fetal mortality (fetal deaths per 1,000 live births) and infant mortality (deaths of infants within the first year of age per 1,000 live births).

Preterm and very low birth weight (VLBW) births were used in calculating potential cost savings. In the U.S. in 2010, 40 percent of preterm births were low birth weight and two-thirds of LBW infants were also infants born prematurely (Martin et al., 2012). In a 2010 California Office Statewide Health Planning and Development (OSHPD) birth cohort data, VLBW infants totaled only 0.9% of births, yet accounted for 35.7% of total hospital costs, and very preterm cases were only 1.9% of births, yet represented 35.5% of total hospital costs (Schmitt, Sneed, & Phibbs, 2006). The economic impact of the MOMS program can be estimated by calculating the prevented VLBW and preterm births.

Cost Savings. Potential cost savings (net benefit) associated with the MOMS program was calculated using the following formula. Estimated total benefits of birth outcomes (difference in premature births and VLBW births) in dollar amount between MOMS and comparison groups (Orange County and California) minus the total cost of MOMS prenatal program. To our knowledge, the most comprehensive cost analysis related to preterm infants were reported in constant 2005 dollars (IOM, 2007) and VLBW costs were reported in 1987 dollars (Rogowski, 1998). Given that medical costs have dramatically increased over the past decade and given the need to adjust for inflation, the costs were converted into 2010 constant dollars based on the Consumer Price Index (Rogowski, 1998; U.S. Bureau of Labor Statistics, 2014).

Preterm birth and VLBW cost savings were calculated based on the most recent, rigorous economic analysis available and adjusted for inflation to the year 2010, when the MOMS data was collected. The estimated cost of a preterm birth ($51,600 in constant 2005 U.S. dollars) was obtained from one key systematic review, which remains one of very few studies calculating the annual societal cost burden of a preterm birth in the U.S. (IOM, 2007). In order to adjust for inflation, $51,600 was converted to 2010 U.S. dollars, equaling $63,019 (U.S. Bureau of Labor Statistics, 2014). This estimate implies that we can save $63,019 for each live baby not born prematurely. The estimated costs of a VLBW ($93,800 in constant 1987 dollars) were obtained from a study using California data, including inpatient and outpatient care received for a first-year VLBW survivor (Rogowski, 1998). In order to accurately index the current amount of medical costs, the 1987 study's calculation of $93,800 was adjusted for inflation to 2010 U.S. dollars equaling $296,702, the savings that can be realized by preventing one VLBW (U.S. Bureau of Labor Statistics, 2014).

The difference in preterm birth numbers between MOMS and an Orange County cohort was obtained by calculating the number of preterm births from a randomly selected sample of the MOMS program *(N* = 1,102) as compared to Orange County in 2010. VLBW births were all premature births in the MOMS data set. In order to avoid calculating the expenses redundantly, we excluded VLBW births from the total number of premature births. The total net benefit (cost savings) of the MOMS program generated was the sum of costs associated with premature births and VLBW births in county and state levels minus program costs for MOMS prenatal program in 2010.

To calculate the economic impact of the MOMS program in costs savings through premature birth prevention (excluding the VLBW births), we utilized the following formula:

Number of live births of MOMS x [(comparison premature rate – comparison VLBW rate) – (MOMS premature rate – MOMS VLBW rate)] x the estimated costs of a preterm birth

To calculate the economic impact of the MOMS program in costs savings through lower VLBW births, we utilized the following formula:

Number of live births of MOMS x (comparison VLBW rate – MOMS VLBW rate) x the estimated costs of a VLBW birth

To calculate the total net benefit, or cost savings, generated by the MOMS program, we utilized the following formula:

The total cost savings from lower premature births and VLBW births of the MOMS program – total costs of MOMS prenatal program.

Analyses

Data were analyzed using the IBM SPSS, version 21.0 for Windows (SPSS, Inc., Chicago, IL, USA). Descriptive statistics (frequencies and percentages) were used to summarize the indicators of socioeconomic background and birth outcomes. The distribution of birth outcomes was summarized according to self-reported maternal ethnicity. Chi-square analyses were conducted to compare significant differences in socioeconomic factors and birth outcomes between MOMS and comparison groups from county and state databases. Chi-square tests were also conducted to examine significant differences across groups for maternal ethnicity among birth outcomes ($p < .05$ was considered significant).

Results

Social Background

Table 1 describes the social background characteristics of women across MOMS Orange County (MOMS OC), Orange County (OC), and California (CA), who gave birth to live infants in 2010. The results show that women in the MOMS program had significantly higher risk profiles for negative birth outcomes compared with their counterparts at the County and State levels. MOMS clients had twice the teen pregnancy rate (9.89%) compared to women in OC (5.60%). A large proportion of women in the MOMS program were Hispanic (80.69%), while only about half of the women in OC (48.30%) and CA (50.60%) were Hispanic; nearly half of the women in the MOMS program (44.99%) did not complete high school compared with appropriately one-fifth of women in OC (22.70%) and CA (20.40%). The majority of the MOMS clients (79.78%) lived in poverty, with their family's income being under or equal to 100% of Federal Poverty Guideline in contrast to the women in OC (39.6%) or CA (44.0%).

Birth Outcomes

A comparison of three adverse birth outcomes is provided in Table 2. Overall, the differences in proportions of preterm births were significant between MOMS and all comparison groups: mothers enrolled in the MOMS program were less likely to have preterm births than other mothers in OC ($X^2(1) = 9.41$, $p = 0.002$), or CA ($X^2(1) = 14.89$, $p < 0.001$). A similar statistically significant pattern was found in Hispanic women, but not in non-Hispanic White women. Hispanic mothers in the MOMS program had significantly fewer preterm births than their counterparts in OC ($X^2(1) = 4.41$, $p = 0.036$), or CA ($X^2(1) = 9.15$, $p = 0.002$).

Table 1.

Social Backgrounds of Mothers from MOMS, and those in County and State Databases

	MOMS (n = 1,102)[a]	Orange County (n = 38,237)[a]	California (n = 509,979)[a]
Demographics	Frequency (%)	Frequency (%)	Frequency (%)
Age group (year)			
15-19	109 (9.89)	2,141 (5.60)	45, 388 (8.90)
20-34	771 (69.96)	26,919 (70.40)	366, 164 (71.80)
>= 35	222 (20.15)	9,215 (24.10)	98, 425 (19.30)
	Reference [b]	χ^2 = 41.55***	χ^2 = 2.14
Ethnicity			
Hispanic	861 (80.69)	18,468 (48.30)	258,049 (50.60)
Non-Hispanic White	70 (6.56)	11,548 (30.20)	149,424 (29.30)
Non-Hispanic Asian	124 (11.62)	7,609 (19.90)	69,867 (13.70)
Non-Hispanic Black	12 (1.12)	459 (1.20)	30,599 (6.00)
	Reference [b]	X^2 = 452.24***	X^2 = 422.46***
Education			
Less than high school	489 (44.99)	8,680 (22.70)	104,036 (20.40)
High school +	598 (55.01)	29,557 (77.30)	405,943 (79.60)
	Reference [b]	X^2 = 293.59***	X^2 = 403.01***
Poverty level [c]			
0-100%	647 (79.77)	15,142 (39.60)	224,391 (44.00)
101%-200%	153 (18.87)	7,686 (20.10)	101,996 (20.00)
201% and higher	11 (1.36)	15,410 (40.30)	183,592 (36.00)
	Reference [b]	X^2 = 622.66***	X^2 = 506.14***
Prenatal insurance			
Medi-Cal	1031 (94.67)	17,130 (44.80)	265,189 (52.00)
Private or other	57 (5.23)	19,539 (51.10)	230,001 (45.10)
Uninsured	1 (0.09)	1,568 (4.10)	14,789 (2.90)
	Reference [b]	X^2 = 1060.00***	X^2 = 793.17***
Place of mother's birth			
Outside the U.S.	630 (60.81)	19,080 (49.90)	211,131 (41.40)
Inside the U.S.	406 (39.19)	19,157 (50.10)	298,847 (58.60)
	Reference [b]	X^2 = 48.04***	X^2 = 160.53***

[a] Total live births.
[b] Compared relevant demographic data between MOMS Orange County as the reference group and Orange County and California respectively.
[c] Poverty level refers to income as a percent of the Federal Poverty Guideline.
***p<0.001

Table 2.

Preterm, Low Birth Weight, and Very Low Birth Weight Births: MOMS vs. County/State Databases

	MOMS [a] Frequency (%)	Orange County [b] Frequency (%)	California [c] Frequency (%)
Preterm births	69 (6.26)	3, 412 (8.90)	49, 490 (9.70)
Hispanic	58 (6.74)	1, 666 (8.80)	25, 229 (9.81)
Non-Hispanic White	3 (4.29)	1, 038 (9.10)	12, 373 (8.80)
LBW births	64 (5.89)	2,462 (6.44)	34, 692 (6.80)
Hispanic	43 (4.99)	1,103 (5.83)	15, 879 (6.17)
Non-Hispanic White	3 (4.29)	771 (6.76)	9, 571 (6.80)
VLBW births	8 (0.73)	362 (0.95)	5, 859 (1.15)
Hispanic	7(0.81)	160 (0.85)	2, 774 (1.08)
Non-Hispanic White	0 (0.00)	126 (1.10)	1, 589 (1.13)

LBW=low birth weight (<2,500g); VLBW = very low birth weight (<1,500g).
[a] MOMS total live births = 1,102; MOMS Hispanic live births = 861.
MOMS Non-Hispanic White live births = 70. [b] Orange County (OC) total live births = 38, 237.
OC Hispanic live births = 18, 930; OC Non-Hispanic White live births = 11, 408.
[c] California State (CA) total live births = 509,979; CA Hispanic live births = 257, 269;
CA Non-Hispanic White live births = 140, 670.

Table 3 includes a comparison of mortality rates in 2010 for MOMS, OC, and CA. Women served by the MOMS program had a lower fetal mortality rate (.91 vs. 4.52 vs. 5.07/1,000 live births) and infant mortality rate (.91 vs. 3.84 vs. 4.74/1,000 live births)**.** The same pattern was identified in both the Hispanic and non-Hispanic White groups. MOMS had a strikingly low number of fetal and infant deaths ranging from 0 to 1. Because a chi-square analysis requires the average expected count of five or more, the differences in mortality rates between MOMS and the comparison groups could not be tested with this statistical analysis (Yates, Moore, & McCabe, 1999).

Table 3.

Comparison of Fetal and Infant Mortality: MOMS vs. County/State Databases

	MOMS [a]	Orange County[b]	California[c]	MOMS	Orange County	California
	Number of deaths			Mortality rate per 1,000 live births		
Total fetal deaths	1	173	2,587	0.91	4.52	5.07
Hispanic	0	102	1,243	0	5.39	4.83
Non-Hisp. White	0	46	670	0	4.03	4.76
Total Infant deaths	1	147	2, 419	0.91	3.84	4.74
Hispanic	1	86	1, 264	1.16	4.54	4.91
Non-Hisp. White	0	38	579	0	3.33	4.12

[a] MOMS total live births = 1,102; MOMS Hispanic live births = 861;
MOMS Non-Hispanic White live births = 70. [b] Orange County (OC) total live births = 38, 237;
OC Hispanic live births = 18, 930; OC non-Hispanic White live births = 11, 408.
[c] California (CA) total live births = 509,979; CA Hispanic live births = 257, 269;
CA Non-Hispanic White live births = 140, 670.

Estimated Costs and Cost Savings

In 2010, 6.26% of MOMS babies were born prematurely as compared to 8.90% countywide and 9.7% statewide. As discussed previously, the estimated lifetime cost of a preterm birth in U.S. was approximately $51,600 in constant 2005 dollars (IOM, 2007), or when adjusted for inflation, $63,019 in 2010 dollars. With the MOMS caseload of 1,102 births and a prematurity rate far below the county and state figures, the MOMS program generated a savings of $1,680,616 countywide, and $2,097,297 statewide (calculated costs saved from a lower rate of premature births).

At MOMS, 0.73% of infants were born with VLBW. This compares with 0.95% in OC, and 1.15% in CA. An estimated cost of VLBW in CA, including the average medical expenses of an infant born with VLBW in the first year, was $93,800 in constant 1987 dollars (Rogowski, 1998) and $296,702 in 2010 adjusted U.S. dollars. Thus, for 1,102 births, MOMS generated a cost savings of $719,324 countywide and $1,373,256 statewide (calculated costs saved from a lower rate of VLBW infants).

The total cost savings from improved birth outcomes for infants and families enrolled in the MOMS prenatal program in OC in 2010 was $2,399,940 (sum of savings of $1,680,616 for reducing premature births added to the savings of $719,324 for prevented VLBW births). According to the MOMS 2010 annual report, MOMS spent $1,339,143 for their prenatal program serving 1,102 families. Therefore, the total potential net cost savings directly derived from improved birth outcomes from the MOMS prenatal program in 2010 was $1,060,797 (difference between $2,399,940 and $1,339,143) in OC and respectively $2,131,410 in CA. These findings support the assertion that fewer preterm and VLBW births resulting from the MOMS program could potential serve as a model for future cost savings at both county and state levels.

Discussion

In this evaluation of the economic impact of the MOMS home visitation program through improved birth outcomes, several key benefits of the program are evident. Women served by the MOMS program had an overall lower socioeconomic status, with more teen pregnancies, greater poverty and less education, compared with women from OC and CA. Despite being more disadvantaged, our results find that women who participated in the MOMS home visitation program had significantly fewer infants born prematurely as compared with women countywide and statewide. Additionally, the MOMS participants were also found to have fewer LBW and VLBW births than women with live births in OC and CA, although this was not a statistically significant difference. Our preliminary findings indicate that the MOMS program participants may have improved birth outcomes, which is supported by our previous study's findings that increased numbers of MOMS prenatal home visits resulted in consistent gains in birthweight and gestational age at birth (Guo et al., 2016). Other evaluations of prenatal home visitation programs implemented in underserved communities have reported similar reductions in premature and LBW births (Nguyen, Carson, Parris, & Place, 2003; Wells et al., 2008).

Our results supported that enhanced birth outcomes (fewer premature births) were more pronounced in the Hispanic MOMS participants compared to non-Hispanic White participants. A recent study found a similar pattern: Hussaini et al. (2011) compared newborn birth weights between mothers enrolled in the Healthy Start program and nonparticipants with similar backgrounds in Arizona. Consistent with the results from our study, Hussaini concluded that Hispanic mothers in the Healthy Start program were almost three times more likely to have an infant with normal birth weight compared to Hispanic non-participant mothers; yet White participants did not have an improvement in likelihood of having a normal-weight infant compared with White non-participants (Hussaini, Holley, & Ritenour, 2011).

According to the three formulas described in the Methods Section and the findings reported in the Results Section, the cost analyses of our study found that the MOMS program generated approximately $1.1 million and $2.1 million in annual savings due to lower preterm and VLBW infant births compared with county and state populations. It is important to note that the estimate of savings is relatively conservative in the present study. Specifically, the average cost used to calculate the savings for preterm and VLBW births are underestimated. For example, studies show that premature infants are also at increased risks of adult onset medical conditions, such as hypertension and type II diabetes (Class, Rickert, Lichtenstein, & D'Onofrio, 2014; James-Todd et al., 2013). The estimated cost of a preterm birth ($51,600 in constant 2005 U.S. dollars) we used to calculate the cost savings only covered the medical costs until age five; long-term medical expenses are not easy to track, and thus, were not included in the national systematic review (IOM, 2007).

It is also important to note that the mean cost of a VLBW infant ($93,800) only included the incurred medical expenses during the first year. Studies found that children who were VLBW infants have lower physical, cognitive, emotional and social functioning than their term infant counterparts and such discrepancies persisted throughout adolescence and young adulthood (Dahl et al., 2006; Zwicker & Harris, 2008; Saigal et al., 2006). These discrepancies result in VLBW children utilizing more medical care, development, special education and early intervention services, yet very few studies of VLBW children are available to provide costs beyond health care services in infancy in the U.S. This study adds evidence to the body of knowledge and public health agenda that reducing preterm births and VLBW births through prevention strategies will result in a significant savings of community resources.

Limitations

As suggested by the findings in this study, the MOMS program may serve as a model for improving birth outcomes with potential cost savings. However, certain study limitations restrict our conclusions. First, the county and state data were based upon annual statistical reports rather than birth certificate data. The full range of risk factors for birth outcomes was not available in the current study, since the data was missing information such as health history, substance and alcohol abuse, and pregnancy complications. Therefore, we were not able to adjust for all covariates relevant to adverse birth outcomes. A much stronger approach to studying the relative benefits of a program would be to conduct a two-group design with one group serving as a control. Future studies using risk adjustment for covariates with more rigorous design might show the extent to which the MOMS program alone leads to improved birth outcomes.

Secondly, the findings of this study of the effects of the MOMS program must be interpreted with caution. Approximately 40% of MOMS Hispanic participants were from Mexico, and studies have suggested that mothers of Mexican descent tend to have better birth outcomes despite low socioeconomic status (Gould, Madan, Qin, & Chavez, 2003). The favorable birth outcomes for the Hispanic population in this present study may be due to factors such as healthier prenatal behaviors and lower substance abuse (Reichman, Hamilton, Hummer, & Padilla, 2008). In this study substantial data about our mothers' substance using behaviors and other health factors that may place them at risk, such as diabetes, was lacking. Without access to data about additional factors placing women at risk, we are unable to determine if the outcome of fewer premature births is due solely to the effects of the MOMS program or to these other confounding factors.

Thirdly, more rigorous economic analyses are also needed. For example, cost-benefit analysis would provide data as to whether the benefit of the MOMS program merits its cost; and cost-effectiveness analysis would compare the costs and outcomes between the MOMS program and other community outreach and home visitation programs (Petrou, 2003). Lastly, given that the study is from Orange County in California during a single year, the generalization of these findings is limited. To increase generalizability, future research would need to investigate the

effect of MOMS home-visitation programs in other at risk communities, states or countries.

Conclusions

The results of this study suggest that the MOMS home visitation program is worthy of further investigation with a more rigorous design to lend confidence to the generalizability of the findings. The MOMS model may make a significant contribution to addressing the stark disparities in birth outcomes facing underserved populations, and may impact at risk families' present and future health, including their clinical, economic and social well-being. In the U.S., the six currently used national home visitation programs are based on either a public health nurse model or paraprofessional model (Thompson, Clark, Howland, & Mueller, 2011). The MOMS program innovatively combines both models through a collaborative approach: in the MOMS model, nurses' home visitation responsibilities expand beyond direct provision of screening, health education, and referrals to supervision and case management of a team of paraprofessionals who implement the home visitations and coordinate community resources. The emphasis on coordination between nurses and paraprofessionals in the MOMS program is well aligned with one of the benchmarks of the Patient Protection and Affordable Care Act for a home visitation program: "improvements in the coordination and referrals for community resources and supports" (H.R. 3590, 2010). The MOMS coordinated home visitation program may provide a cost-effective model for promoting healthy pregnancies and reducing the disparities in adverse birth outcomes for underserved communities.

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