

## Risk factors for preeclampsia in a high-risk cohort of women served by a nursing-based home visiting program

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### Abstract

This descriptive study aimed to identify the impact of psychosocial risk factors on pregnancy outcomes for high risk women in an urban setting. Women in this category tend to experience adverse pregnancy outcomes, like preeclampsia, at greater rates than low or medium risk women. A retrospective paper chart review of East Harlem women served by LSA Family Health Service (LSA) Maternal Outreach Program (MOP) was conducted. All women who enrolled in the MOP with a singleton pregnancy from January 2015 to December 2017, were eligible for inclusion in our analyses. Data were analyzed using SPSS (version 23). Of 379 total participants, 68.6% (n = 203) were Hispanic/Latina women, 44.8% (n = 163) were English only speakers, 67.4% (n = 226) were identified as overweight/obese, 90.6% (n = 328) were mothers over the age of 20 among those for whom data were available. Sixty-two percent (n = 235) initiated prenatal care in their first trimester, and 71.5% (n = 271) were referred to the MOP by a hospital or other healthcare provider. The percentage of preeclampsia among mothers was 26.9% (n = 102). After adjustment for type of LSA services received, and race/ethnicity, there were no associations between psychosocial risk factors and preeclampsia diagnosis in this population. Further research is needed on the relationship between psychosocial risk factors and preeclampsia to identify potential areas of intervention and reduce the burden of disease.

**Keywords:** Preeclampsia, home visits, nursing, social determinants of health, pregnancy

### Introduction

Preeclampsia is a disorder of pregnancy that is characterized by new onset hypertension along with cerebral or visual symptoms, pulmonary edema or laboratory abnormalities indicating thrombocytopenia, transaminitis or renal dysfunction, during pregnancy or immediately postpartum (1). The diagnosis can be present at any stage of gestation but

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is more commonly encountered in the third trimester or up to six weeks postpartum (2). The prevalence of preeclampsia and other pregnancy related hypertensive disorders is estimated to be between 2-8% globally (3-5). Hypertensive pregnancy disorders are responsible for more than one quarter of maternal deaths in Latin America and the Caribbean (3). In the United States, racial and ethnic disparities in the prevalence of preeclampsia persist. One study found that Mexican women had higher preeclampsia rates compared to non-Hispanic White and East Asian women (6). Another study of pregnant New York City women found that among women with pre-existing diabetes, Hispanic and non-Hispanic Black women were more likely to have preeclampsia than non-Hispanic White women after adjustment for confounders (7).

Hospital discharge data show that African American women compared to other racial and ethnic groups (8). Known risk factors for preeclampsia include: nulliparity, chronic hypertension, diabetes and obesity (9-10). Mothers younger than 20 years or older than 35 years of age are also more likely to be diagnosed with preeclampsia (10). Pre-eclampsia is associated with poorer birth outcomes such as increased likelihood of having a preterm or low birth weight infant since delivery via induction of labor continues to be the mainstay of treatment for affected women (11-12). Although the maternal comorbidities associated with this disorder have been well documented, there is less research on the psychosocial risk factors associated with this important pregnancy complication. The purpose of our descriptive study is to identify social risk factors for preeclampsia in a high-risk cohort of mothers who received skilled home nursing visits through the Maternal Outreach Program (MOP) at LSA Family Health Service (LSA) to identify additional areas for intervention.

## Methods

LSA Family Health Service (LSA) is a non-profit community organization located in East Harlem, New York. This neighborhood has historically been the home to several immigrant communities, becoming one of the largest minority communities in New York City with more than three quarters of the population

identifying as Latino/Hispanic or Black/African American (13). The median income is approximately \$38,000 in both East and Central Harlem with about 30% living below the federal poverty level (14-15). This organization provides social and health services to address many aspects of family health and incorporates a home and center-based program, led by a combination of community health workers and public health nurses, designed to empower those who are vulnerable and have limited access to necessary resources needed to cultivate a healthy life. The LSA Maternal Outreach Program (MOP) consists of a team of community nurses who provide care to prenatal and postpartum women residing in East and Central Harlem by conducting home-visits and providing individualized prenatal and infant care education as well as breastfeeding classes. Additional services provided by LSA to promote community health/wellness and family support include: The Advocacy and Food Pantry Program, Environmental Health Services, Parenting and Child Development, and Preventive Services.

### *Study population*

The study population consisted of pregnant and postpartum women served by LSA. Women were referred to the MOP if there was a perceived need and potential benefit from receiving home nursing care and community support. Women also self-referred if interested, based on community awareness of the organization and services offered. All women with singleton pregnancies, who were clients of the MOP during 2015-2017, were eligible for inclusion in our study.

### *Study design*

A retrospective paper chart review of program data on mother-infant dyads was conducted by trained research assistants. Data were analyzed with SPSS software (SPSS version 23). Chi square analyses and logistic regression was used to model associations between preeclampsia and psychosocial risk factors identified by the nurses during program intake. Risk factors of interest included: being a teen or

inexperienced parent, (defined as being a mother less than 20 years or being a first time mother); having food insecurity, insufficient income; low maternal education, (defined as less than a 10th grade education or leaving school before age 17), poor housing quality, and perceived neighborhood safety.

## Results

The study population consisted of a total of 379 mothers with singleton pregnancies. More than two thirds of the women (n = 257) were enrolled in the postpartum-only component of the MOP. About one quarter (n = 94), enrolled in both the prenatal and postpartum components of the MOP. Less than 10% (n = 28) participated in the prenatal program only. Table 1 summarizes the demographic information of the MOP participants stratified by type of LSA

services received. More than two thirds (68.6%) of the women identified as Latina and, 28% were African American. The group of women who received only postpartum services had the lowest percentage of Latina women (57.9%) and the highest percentage of Black women (37.7%) compared to the other groups (p < 0.01). The postpartum only group also had the highest percentage of women who spoke primarily English (56.8%). In comparison, the group with the highest percentage of Spanish only speakers was the prenatal-postpartum group (56.4%). BMI was elevated in about two thirds of the women in all three groups with minimal between group differences. Eighty-seven percent of women enrolled in the postpartum-only program were referred by a hospital or clinic compared to less than 40% in the prenatal only and prenatal-postpartum participants of the MOP combined.

**Table 1. Demographic information by type of service received**

	All (n = 379)	Prenatal Only (n = 28)	Postpartum Only (n = 257)	Prenatal-Postpartum (n = 94)	P-value
Race/Ethnicity*					<0.01
Black/African-American	27.7%	8.7%	37.7%	12.2%	
Hispanic/Latina	68.6%	87.0%	57.9%	85.6%	
Other	3.7%	4.3%	4.4%	2.2%	
Language*					<0.01
English Only	44.8%	29.6%	56.8%	18.1%	
Spanish Only	28.8%	44.4%	16.4%	56.4%	
Bilingual	23.4%	22.2%	23.9%	22.3%	
Other	3.0%	3.7%	2.9%	3.2%	
BMI Class*					0.04
Underweight	3.7%	8.0%	3.3%	3.4%	
Normal	28.9%	28.0%	27.3%	29.7%	
Overweight/Obese	67.4%	64.0%	69.4%	66.9%	
Maternal Age <20 yrs*					0.64
Yes	9.4%	7.1%	10.4%	7.4%	
No	90.6%	92.9%	89.6%	92.6%	
Trimester of Prenatal Care Initiation					<0.01
First	62.0%	64.3%	80.9%	54.9%	
Second or Later	4.0%	****	5.3%	3.9%	
Unknown	34.0%	35.7%	13.8%	41.2%	
Referral Source					<0.01
Hospital or healthcare provider	71.5%	39.3%	87.2%	38.3%	
Self or other individual	12.1%	35.7%	2.3%	31.9%	
LSA or other organization	8.7%	25.0%	0.8%	25.5%	
Missing/Unknown	7.7%	N/A	9.7%	4.3%	

\*Of the participants for whom data were available.

**Table 2. Psychosocial risk factors by type of LSA services received**

	All (n = 379)	Prenatal Only (n = 28)	Postpartum Only (n = 257)	Prenatal-Postpartum (n = 94)	P-value
Teen/Inexperienced Parenting*					0.64
Yes	44.6%	50.0%	45.3%	40.9%	
No	55.4%	50.0%	54.7%	59.1%	
Low Maternal Education *					<0.01
Yes	24.6%	35.7%	16.1%	44.6%	
No	75.4%	64.3%	83.9%	55.4%	
Food Insecurity*					<0.01
Yes	23.1%	21.4%	18.4%	36.7%	
No	76.9%	78.6%	81.6%	63.3%	
Insufficient Income*					<0.01
Yes	34.0%	28.6%	28.5%	51.1%	
No	66.0%	71.4%	72.5%	48.9%	
Substandard Housing Quality*					<0.01
Yes	26.9%	32.1%	15.8%	57.5%	
No	73.1%	67.9%	84.2%	42.5%	
High Risk/Unsafe Neighborhood*					<0.01
Yes	13.3%	N/A	11.9%	21.6%	
No	86.7%	100%	88.1%	78.4%	

\*Of the participants for whom data were available.

**Table 3. Percentage of pre-eclampsia diagnosis by psychosocial risk factor stratified by LSA service received**

	All (n = 379)	Prenatal Only (n=28)	Postpartum Only (n = 257)	Prenatal-Postpartum (n = 94)	Overall P-value
Total Prevalence					N/A
	26.9%	3.6%	34.2%	13.8%	
Teen/Inexperienced Parenting					0.06
Yes	22.1%	7.1%	27.9%	10.5%	
No	30.9%	***	40.6%	14.5%	
Low Maternal Education					<0.01
Yes	13.6%	***	27.0%	4.9%	
No	30.5%	5.6%	35.7%	17.6%	
Food Insecurity					0.72
Yes	25.3%	16.7%	29.5%	18.2%	
No	27.3%	***	35.2%	10.5%	
Insufficient Income					0.12
Yes	21.8%	12.5%	30.4%	10.6%	
No	29.3%	***	36.2%	15.6%	
Substandard Housing Quality					0.02
Yes	17.5%	***	28.9%	12.0%	
No	29.9%	5.3%	35.6%	10.8%	
High Risk/Unsafe Neighborhood					0.70
Yes	24.5%	***	34.7%	10.5%	
No	27.2%	3.6%	33.3%	13.0%	

Table 2 outlines the prevalence of our psychosocial risk factors by LSA service type. Generally, participants who were only enrolled in the postpartum program were the least likely to report low maternal education, food insecurity, insufficient income, substandard housing quality and living in a high risk or unsafe neighborhood (all  $p < 0.01$ ).

### *Preeclampsia in the MOP*

Table 3 summarizes the percentage of women with preeclampsia by psychosocial risk factor, stratified by type of LSA services received. Preeclampsia rates were lower among women with less maternal education (13.6% vs 30.5%,  $p < 0.01$ ) and those with

poor housing (17.5% vs 29.9%,  $p = 0.02$ ). Table 4 highlights the odds of preeclampsia in clients of the MOP with select risk factors. Consistent with the findings in Table 3, the odds of preeclampsia were 64% lower in women with low maternal education (OR 0.36, 95%CI 0.186-0.697) and 50% lower in women who lived in poor quality housing (OR 0.50, 95%CI 0.277-0.894). However, after adjustment for race/ethnicity and type of LSA services received, these differences were no longer statistically significant (Adj OR 0.53, 95%CI 0.243-1.131 and Adj OR 0.67, 95%CI 0.321-1.377). There were no statistically significant associations between preeclampsia and food insecurity, income, teen/inexperienced parenting or perceived neighborhood safety.

**Table 4. Odds of preeclampsia by psychosocial risk factor**

	Unadjusted OR (95%CI)	Partially Adjusted OR (95%CI) <sup>a</sup>	Adjusted OR <sup>b</sup> (95%CI)
Teen/Inexperienced Parenting	0.63 (0.395, 1.017)	0.61 (0.372, 0.992)	0.63 (0.351, 1.119)
Low Maternal Education	0.36 (0.186, 0.697)	0.51 (0.256, 1.022)	0.53 (0.243, 1.131)
Food Insecurity	0.83 (0.475, 1.454)	1.03 (0.568, 1.868)	1.05 (0.519, 2.109)
Insufficient Income	0.67 (0.403, 1.115)	0.79 (0.464, 1.345)	0.65 (0.342, 1.231)
Substandard Housing Quality	0.50 (0.277, 0.894)	0.79 (0.416, 1.510)	0.67 (0.321, 1.377)
High Risk/ Unsafe Neighborhood	0.87 (0.433, 1.747)	0.91 (0.440, 1.864)	0.91 (0.375, 2.184)

<sup>a</sup>Adjusted for type LSAFHS Services type <sup>b</sup>Adjusted for type of LSAFHS services type, and race/ethnicity.

## Discussion

The present study is among the first to fully explore the potential impacts of various psychosocial risk factors on preeclampsia for an at-risk, minority population receiving skilled home nursing visits. Demographic analysis of our study population confirms that the MOP at LSA serves a high-risk population. The group was primarily comprised of English-speaking Latina women categorized into overweight and obese groups by their calculated BMI, which is consistent with previous research identifying an increased risk of preeclampsia in women with this risk factor (16).

These results differ from existing literature on teen and inexperienced parenting as a preeclampsia

risk factor. Fewer women in the teen/inexperienced parent category had a diagnosis of preeclampsia, but this relationship was not significant after adjustment for race/ethnicity and type of LSA service received. Other studies have associated young maternal age (under 20 years old), with an increased risk of preeclampsia, especially among racial and ethnic minorities (17). LSA's definition of 'inexperienced parent' also includes nulliparous women who may have more anticipated stress related to preparation for becoming a first-time parent. There is literature which suggests that perceived stress and nulliparity may be associated with the development of preeclampsia during pregnancy (18, 19). The LSA category for teen and inexperienced parents was a combination of these two populations. Therefore, it is possible that the

association between teen parenting and preeclampsia, as well as the association between parenting experience and preeclampsia, may have been masked. Further research should explore teen parenting, parenting experience and parental stress as individual risk factors for this disorder within this population. Women with low maternal education also had lower rates of preeclampsia. However, this relationship appeared to be explained by differences in the distributions of LSA service type and race/ethnicity. This finding disagrees with existing works that associate low maternal education with a greater risk of preeclampsia (19, 20). One possible explanation is differences by nativity status. Foreign-born women tend to have better birth outcomes than those born in the United States regardless of racial or ethnic background (21). Therefore, a study population with a higher percentage of foreign-born women may have lower education but better birth outcomes nonetheless. Nativity was beyond the scope of our data analyses.

We did not find any significant association between nurse-reported insufficient income or food insecurity and having preeclampsia. This too, is in contrast with relevant literature that cites low

socioeconomic status as being positively associated with preeclampsia development (22). Household income data were not available for analyses so we were unable to identify discrepancies between mothers' perceived income insufficiency, and measured income that could have provided additional insight into our findings. It is possible that the mothers' perception of whether the household income was sufficient may not have correlated well with their true income. Additional research with more direct, quantitative measures of income insufficiency is warranted. Similarly, there were no differences in preeclampsia rates among those who reported and those who did not report food insecurity. One explanation is that the nurses' intake form did not note the type of food that was available at home or the nutritional content of what the women ate. Research shows that risk of preeclampsia may be increased by diets that are high in fat or deficient in calcium (23-24). Other studies suggest that increased intake of added sugars is associated with the development of preeclampsia (25). Therefore, mothers with preeclampsia may have had access to a greater quantity of food of poorer quality which may have impacted our results.

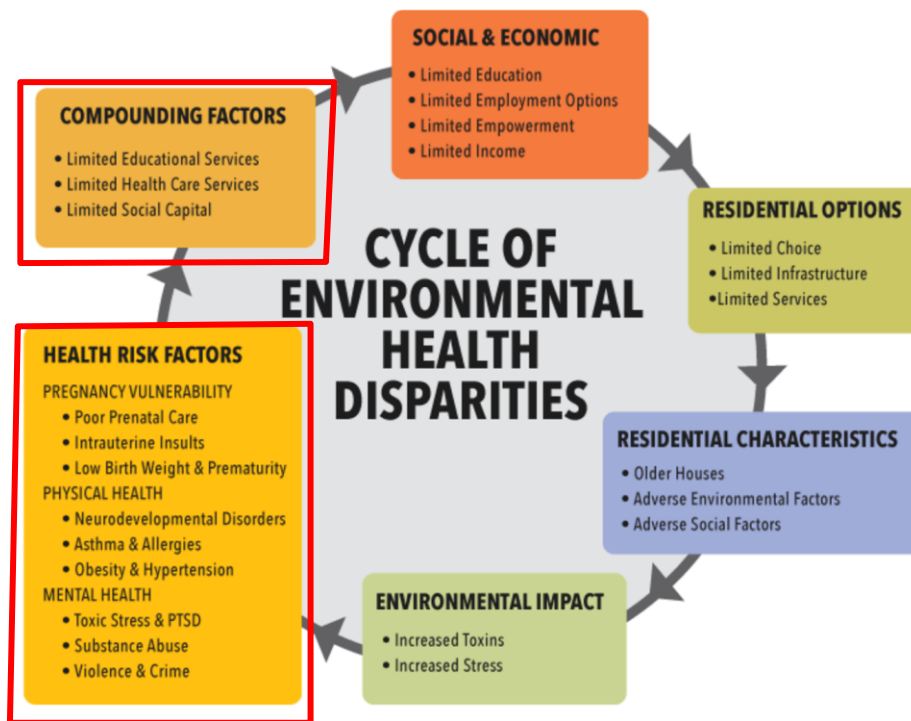


Figure 1. Areas in the cycle of health disparities targeted by LSAFHS.

<p><b>Teen/Inexperienced parent:</b> Mother less than 20 years of age, or being a first time mother.</p> <p><b>Low maternal education:</b> Mother who left school before age 17 or had less than 10<sup>th</sup> grade education.</p> <p><b>Food insecurity:</b> Defined as a report of not enough food or only nutritionally deficient food in the home.</p> <p><b>Insufficient income:</b> Not enough income to meet basic needs such as food, housing, healthcare and supplies.</p> <p><b>High-risk/unsafe neighborhood:</b> Perceived presence of or concern for safety in the building where they reside.</p> <p><b>Substandard Housing:</b> Presence of less than adequate housing conditions such as apartment or building fixtures in poor condition, non-functioning windows, deteriorating flooring and walls.</p>
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Figure 2. Risk factor definitions used by LSAFHS nurses.

After adjustment for the covariates, there was no significant association between housing quality or neighborhood safety and preeclampsia. Established literature cites that residents who live in substandard housing are more likely to have additional socio-economic risk factors, such as living in an unsafe neighborhood that increase levels of chronic stress and poorer mental health, which then increases risk of adverse birth outcomes, including preeclampsia (26). While this study's results diverge from these findings, it is possible that these two risk factors are less important than medical comorbidities risk factors, like BMI. The distribution of BMI was similar among the three groups of women and modelling BMI in relation to preeclampsia was beyond the scope of our analysis. Alternatively, the risk factor definition may have been too heterogeneous to identify specific environmental housing factors that are associated with preeclampsia.

Of great significance is the finding that women who only participated in the postpartum component were by far more likely to be referred by health care providers for medical conditions. Many of these women had preeclampsia as the referral diagnosis, which is reflected in our data since the postpartum-only group had the highest preeclampsia percentage overall. Though they had higher rates of protective risk factors for preeclampsia, such as higher maternal education level and more income, they were also more likely to identify as Black or African American which is a well-documented preeclampsia risk factor (8, 27). Most of these women did initiate prenatal care within their first trimester but were not referred to MOP for secondary preventive care. This highlights a gap in referrals for participants and a failure to identify high-risk women for additional support for preeclampsia earlier in their pregnancy. Potential reasons for lack of referral include lack of provider awareness of MOP, patient preference, or competing

priorities especially for medically complex or hospitalized mothers and infants. Since preeclampsia is associated with both maternal and infant comorbidity, early detection and disease management are public health priorities. Referrals to skilled, home nursing programs that connect clients to community resources could mitigate some of the adverse outcomes associated with this disorder; and serve as an additional window of opportunity to decrease the maternal and child health disparity gap.

This study demonstrates the ability of a community-based program to successfully track maternal and infant social and environmental risk factors of public health significance. The neighborhood served by the MOP has a significant proportion of mothers who often have less access to traditional health care venues and our study contributes to the body of literature on this important population.

There are however, several limitations, including the small sample size after stratification by program type and risk factors; and the lack of validation of the LSA criteria used for the different psychosocial and environmental risk factors. Other limitations include the inability to assess inter-observer reliability amongst the nurses and members of the data collection teams, as well as the lack of specificity in criteria used to define some of the risk factors of interest. Nevertheless, we did demonstrate the ability of a community-based organization to track data with great public health significance in a systematic way and provide much needed home-base services during and after pregnancy. Additional pilot projects could explore ways of helping community-based organizations improve their data management strategies in a self-sustaining way; and increase their capacity to evaluate their program outcomes and further identify need gaps for the populations they serve.

## Conclusion

We found no association between any of the psychosocial risk factors examined and preeclampsia after adjustment for race/ethnicity and the type of MOP services received in our population. Though our findings differ from the existing literature, they do highlight the importance of carefully considering the criteria that is used to screen mothers for common risk factors. Further research is still needed in order to better characterize risk and to reveal additional links that exist between socioeconomic factors and preeclampsia. Given the long-term negative consequences of this disorder for both mothers and infants, understanding the environmental risk factors for this condition is critical in order to break the cycle of birth outcome disparities that exist in ethnic minority communities. Many of the root causes of maternal and child health disparities are challenging to solve; organizations like LSA provide much needed support and care to marginalized communities

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## Ethical compliance

The authors have stated all possible conflicts of interest within this work. The authors have stated all sources of funding for this work. If this work involved human participants, informed consent was received from each individual. If this work involved human participants, it was conducted in accordance with the 1964 Declaration of Helsinki. If this work involved experiments with humans or animals, it was conducted in accordance with the related institutions' research ethics guidelines.

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