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## The Relationship of Preeclampsia with Maternal Place of Birth and Duration of Residence Among non-Hispanic Black Women in the United States

Ellen Boakye, MD MPH<sup>1,\*</sup>, Garima Sharma, MD<sup>1,\*</sup>, S. Michelle Ogunwole, MD<sup>2</sup>, Sammy Zakaria, MD MPH<sup>3</sup>, Arthur J. Vaught, MD<sup>4</sup>, Yaa Adoma Kwapong, MD MPH<sup>5</sup>, Xiumei Hong, MD PhD<sup>5</sup>, Yuelong Ji, PhD<sup>5</sup>, Laxmi Mehta, MD<sup>6</sup>, Andreea A. Creanga, MD PhD<sup>5,7,8</sup>, Michael J. Blaha, MD MPH<sup>1</sup>, Roger S. Blumenthal, MD<sup>1</sup>, Khurram Nasir, MD MPH MSc<sup>9</sup>, Xiaobin Wang, MD ScD<sup>5</sup>

<sup>1</sup>Johns Hopkins Ciccarone Center for Prevention of Cardiovascular Diseases, Johns Hopkins University School of Medicine, Baltimore, MD, USA

<sup>2</sup>Division of General Internal Medicine, Johns Hopkins University School of Medicine, Baltimore, MD, USA

<sup>3</sup>Division of Cardiology, Department of Medicine, Johns Hopkins University School of Medicine, Baltimore, MD, USA

<sup>4</sup>Department of Maternal Fetal Medicine, Division of Gynecology and Obstetrics, Johns Hopkins University School of Medicine, Baltimore, MD, USA

<sup>5</sup>Department of Population, Family and Reproductive Health, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, USA

<sup>6</sup>Division of Cardiology, Ohio State University School of Medicine, Columbus, OH, USA

<sup>7</sup>Department of International Health, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, USA

<sup>8</sup>Department of Gynecology and Obstetrics, Johns Hopkins University School of Medicine, Baltimore, MD, USA

<sup>9</sup>Houston Methodist Hospital and DeBakey Heart & Vascular Center, Center for Outcomes Research, Houston, TX, USA

### Abstract

**Background:** Preeclampsia is one of the leading causes of maternal mortality in the United States. It disproportionately affects non-Hispanic Black (NHB) women, but little is known about how preeclampsia and other cardiovascular disease (CVD) risk factors vary among different

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Corresponding Author: Garima Sharma MD FACC, Assistant Professor of Medicine, Johns Hopkins University School of Medicine, Ciccarone Center of Prevention of Cardiovascular Disease, 565 C Carnegie Building, 600 N Wolfe Street, Baltimore, MD 21287, Gsharma8@jhmi.edu, Twitter: @GarimaVSharmaMD.

\*Co-first authors and contributed equally to this manuscript

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subpopulations of NHB women in the US. We investigated the prevalence of preeclampsia by nativity (US- vs. foreign-born) and duration of US residence among NHB women.

**Methods:** We analyzed cross-sectional data from the Boston Birth Cohort (1998–2016), with a focus on NHB women. We performed multivariable logistic regression to investigate associations between preeclampsia, nativity and duration of US residence after controlling for potential confounders.

**Results:** Of 2,697 NHB women, 40.5% were foreign-born. Relative to them, US-born NHB women were younger, in higher percentage current smokers, had higher prevalence of obesity (BMI  $\geq 30$  Kg/m<sup>2</sup>) and maternal stress, but lower educational level. The age-adjusted prevalence of preeclampsia was 12.4% and 9.1% among US-born and foreign-born women respectively. When further categorized by duration of US residence, the prevalence of all studied CVD risk factors except for diabetes, was lower among foreign-born NHB women with <10 vs.  $\geq 10$  years of US residence. Additionally, the odds of preeclampsia in foreign-born NHB women with duration of US residence <10 years was 37% lower than in US-born NHB women. In contrast, the odds of preeclampsia in foreign-born NHB women with duration of US residence  $\geq 10$  years was not significantly different from that of US-born NHB women after adjusting for potential confounders.

**Conclusions:** The prevalence of preeclampsia and other CVD risk factors is lower in foreign-born than US-born NHB women. The “healthy immigrant effect”, which typically results in health advantages for foreign-born women, appears to wane with longer duration of US residence ( $\geq 10$  years). Further research is needed to better understand these associations.

### Keywords

Preeclampsia; Health Disparities; Cardiovascular Diseases; Nativity; non-Hispanic Blacks

### Subject Terms:

Race and Ethnicity; Risk Factors; Women; Preeclampsia

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## INTRODUCTION

### Background:

Preeclampsia is among the leading causes of maternal mortality in the United States (US) and continues to be a major cause of maternal and fetal morbidity.<sup>1</sup> Its incidence is increasing, and currently, it affects approximately 5% of all pregnancies in the US,<sup>2</sup> with wide variations based on race, ethnicity and pre-existing cardio-metabolic risk factors.<sup>3</sup> Preeclampsia can lead to serious maternal complications such as eclampsia, stroke, and multiple organ failure.<sup>4,5</sup> Importantly it has been identified as among the most preventable causes of maternal morbidity and mortality.<sup>6</sup> The 2019 ACC/AHA Cardiovascular disease (CVD) Prevention Guidelines recognizes preeclampsia as a sex specific risk enhancing factor for subsequent cardiovascular and cerebrovascular disease in women.<sup>7</sup> Women with a history of preeclampsia have an increased risk of chronic hypertension, ischemic heart disease, heart failure, premature vascular aging, and stroke compared to women with normotensive pregnancies.<sup>8–10</sup> Given the rising US incidence, and effects on pregnancy

morbidity and mortality and long term cardiovascular health, preeclampsia represents a significant public health concern.<sup>11</sup>

Studies have documented a higher risk of preeclampsia, other forms of pregnancy related hypertension, and CVD among non-Hispanic Black (NHB) women in the US compared to their non-Hispanic White (NHW) counterparts.<sup>12–17</sup> Not only are NHB women disproportionately affected by preeclampsia, they are also more likely to die from its complications than NHW women.<sup>18–20</sup> There is considerable heterogeneity in the NHB population in the US based on nativity, immigration status, and other socio-economic measures.<sup>21</sup> Yet most studies that investigated these disparities in preeclampsia and related outcomes have examined NHB women as a homogenous group, with little attention to nativity. Two factors by which NHB women differ are nativity or place of birth (foreign- vs US-born) and the duration of US residence among foreign-born NHB women. Duration of US residence has been used as a proxy for acculturation in previous studies.<sup>22,23</sup> Variations may exist in the risks of preeclampsia, CVD risk factors and adverse pregnancy outcomes between NHB women based on these two factors.

Although immigrants are often considered a vulnerable population and at higher risk of adverse health outcomes, several studies have reported a paradox: immigrant (foreign-born) women tend to have better reproductive health outcomes compared to their US-born counterparts, despite poorer socioeconomic profiles.<sup>24–26</sup> This has previously been demonstrated in the rate of preterm births and small-for-gestational-age (SGA) among NHB women by maternal nativity.<sup>27</sup> This epidemiologic paradox has been attributed to the selective immigration of healthy and educated immigrants into their host country (healthy immigrant effect) and the protective cultural norms of immigrants.<sup>28,29</sup> There is also evidence that this foreign-born advantage may wane with acculturation to the host country.<sup>25,30</sup> Among NHB women residing in the US, little is known about nativity related disparities in the prevalence of preeclampsia. Further, the impact of duration of US residence—a proxy of acculturation—has not been well investigated in association with preeclampsia among NHB women. With 13.5% of the US population being foreign-born (2016)<sup>31</sup> and the growing immigrant population in the US, it is important that these differences in risks are explored to understand how immigration status and duration of residence in the US affect the risk of preeclampsia among NHB women.

### **Objective:**

In this study, we explored the prevalence of preeclampsia among NHB women, focusing specifically on preeclampsia prevalence among the subgroups defined by nativity and duration of US residence, while controlling for other known risk factors.

## **METHODS**

### **Data Source and Study Design:**

Data from the Boston Birth Cohort (BBC) were utilized for this study and it is available on request from the Johns Hopkins Center on the Early Life Origins of Diseases.<sup>32</sup> This study is a secondary data analysis exploring the associations between maternal nativity, duration of

US residence, and prevalence of preeclampsia and associated CVD risk factors among NHB women in the US. We used the 1998–2016 data from the BBC with 8,509 mother-baby dyads recruited at Boston Medical Center (BMC), which serves a predominantly low-income, minority, inner-city patient population. The BBC was started in 1998 with an initial case-control design to study the determinants of low birthweight and preterm births. A case of preterm birth or low birthweight was matched to 2 age- and ethnicity-matched controls (term birth with normal birthweight). The cohort has particular focus on the interaction of environmental factors and genetic variants in adverse reproductive outcomes such as preterm births, pregnancy complications, and pediatric health problems.<sup>33</sup> Mothers who delivered live singleton births at the BMC (from 1998–2016) were recruited within 24–72 hours after delivery and included in the cohort after they had given a written informed consent. Multiple gestations, pregnancies resulting from in vitro fertilization, neonates with chromosomal abnormalities, and major birth defects were excluded.<sup>33,34</sup> After informed consent was obtained, standardized questionnaire interview was conducted to obtain sociodemographic data (including place of birth and length in the US), and maternal and infant electronic medical records (EMR) were reviewed to obtain clinical data on birth outcomes and pregnancy complications including preeclampsia.<sup>34</sup> The BBC was approved by the Institutional Review Board (IRB) of Boston University Medical Center and the IRB of Johns Hopkins Bloomberg School of Public Health. This current study did not require review by an IRB since it used de-identified data from the BBC.

This study focused on data from 2,760 women of the BBC who self-reported as NHB. Of these, 2,697 had data on the main outcome of interest (preeclampsia) and their place of birth, with 1,606 (59.5%) being US-born and 1,091 (40.5%) foreign-born. Among foreign-born NHB women, only 766 had data on duration of residence in the US; thus, a total of 325 foreign-born NHB women missing this information were excluded from the analysis of the prevalence of preeclampsia by duration of US residence. (Figure 1).

### Variables:

The BBC includes information on maternal race/ethnicity, place of birth, sociodemographic characteristics, and traditional risk factors of preeclampsia and other adverse pregnancy and birth outcomes. Self-reported maternal sociodemographic characteristics included maternal age at delivery (<20, 20–34 or 35 years); parity (0, 1 or 2+); and maternal education (secondary school or less, GED/High School graduate or college education/degree). Also available were data on other risk factors for preeclampsia including self-reported maternal perceived stress (mild, moderate, or severe), smoking in pregnancy (yes/no), history of hypertension (yes/no), diabetes (none, gestational and chronic) and body mass index (BMI <25, 25.0–29.9 and 30 kg/m<sup>2</sup>). Chronic hypertension, chronic and gestational diabetes mellitus status were based on physician diagnosis as documented in the EMR. BMI was calculated from self-reported weight and height.

Persons who were born in any of the 50 US states, the District of Columbia and other US territories were considered US-born, and those born outside these regions were considered foreign-born. Duration of U.S residence was defined as the number of years between immigration into the U.S and the index pregnancy and was categorized as <10 years or 10

years. The cutoff of 10 years was used as persons residing in the US for ≥ 10 years are regarded as having higher acculturation and those residing <10 years as having lower acculturation.<sup>35</sup>

The primary outcome of interest in this study was preeclampsia. Clinical diagnosis of preeclampsia in the index pregnancy was obtained from the mothers' medical records using ICD-9 or 10 code, diagnosis name, or keyword. Preeclampsia was defined according to the National High Blood Pressure Education Program Working Group on High Blood Pressure in Pregnancy, as systolic blood pressure (SBP) ≥ 140 mmHg or diastolic blood pressure (DBP) ≥ 90 mmHg on at least two occasions, and proteinuria ≥ 1+ on at least two occasions after 20 weeks' gestation. For women with chronic hypertension, worsening hypertension (SBP ≥ 160 mmHg or DBP ≥ 110 mmHg) was required for the diagnosis of preeclampsia to be met.<sup>36</sup> For analysis purposes, we grouped all women with preeclampsia, eclampsia, and HELLP (hemolysis, elevated liver enzymes, and low platelet count) syndrome into one "preeclampsia" group.

### Statistical Methods:

We used Pearson's chi squared and Fischer exact tests to explore the differences in maternal sociodemographic and medical risk factors by maternal place of birth and duration of US residence. A missing category was included for variables with >1% missing values, and this included BMI and maternal education. Logistic regression analysis with nested models was used to obtain unadjusted and adjusted prevalence odds ratios (aPOR) of preeclampsia by maternal nativity as well as by duration of US residence. Model 1 was unadjusted; Model 2 was age-adjusted; Model 3 was adjusted for maternal age, hypertension, parity, BMI, diabetes, education, smoking and general stress. Predictive margins were used to obtain the adjusted proportion and marginal effects for the models. To examine whether the duration of US residence was associated with the risk of preeclampsia for foreign-born women, we stratified the women into those with duration of residence <10 years and those with ≥ 10 years of US residence. Results were considered statistically significant at  $p < 0.05$ . Stata version 14.2 was used for all statistical analyses in this study.

## RESULTS

The study sample comprised of 1,606 (59.5%) US-born and 1,091 (40.5%) foreign-born NHB women. For the foreign-born population, 42.4% was from the Caribbean, 36.3% from Sub-Saharan Africa, and 21.3% from other regions. The overall prevalence of preeclampsia was 11.1% in this study sample.

### Sociodemographic and Cardiovascular Risk Factors by Maternal Place of Birth

There were significant differences between several CVD risk factors and baseline characteristics between the two groups [Table 1]. Compared to US-born women, more foreign-born women were older (>34 years) at time of delivery (21.0% vs 10.3%;  $p < 0.001$ ) and less foreign-born women were younger (<20 years) at the time of delivery (7.4% vs 18.6%;  $p < 0.001$ ). Although foreign-born women were more likely to be overweight, US-born women had a higher prevalence of obesity ( $\geq 30 \text{ kg/m}^2$ ) (27.6% vs 19.6%;  $p < 0.001$ ) and

chronic diabetes (4.1% vs 3.8%;  $p<0.001$ ) compared to the foreign-born women. However, the foreign-born women were more likely to have gestational diabetes mellitus (GDM) as compared to US-born women (7.3% vs 4.9%;  $p<0.001$ ). In terms of high-risk behaviors for CVD, US-born women had a significantly higher prevalence of smoking in pregnancy (20.5% vs 4.9%;  $p<0.001$ ) compared to the foreign-born women. Maternal stress and education levels were also significantly different between the two groups. US-born women reported more moderate or severe stress during pregnancy than foreign-born women (74.3% vs 60.3%;  $p<0.001$ ); they were also more likely to have lower levels of education (66.3% vs 53.6% without college degree;  $p<0.001$ ). Interestingly, the prevalence of pre-existing hypertension did not differ significantly between US- and foreign-born women (7.8% vs 7.2%,  $p=0.601$ )

### **Prevalence of Preeclampsia by Maternal Place of Birth**

The age-adjusted prevalence of preeclampsia was 12.4% and 9.1% in US-born and foreign-born women, respectively [Figure 2]. Foreign-born NHB women had 27% lower odds of preeclampsia compared to US-born NHB women after adjusting for maternal age, hypertension, parity, smoking, BMI, diabetes, education, and general stress (OR=0.73 CI 0.55–0.97) [Table 2].

### **Sociodemographic and Cardiovascular Risk Factors by Duration of US Residence**

The distribution of CVD risk factors differed with the number of years of US residence for foreign-born NHB women [Table 3]. The prevalence of obesity was highest among US-born NHB women, followed by foreign-born women with 10 years of residence, and much lower in foreign-born with <10 years of residence (27.6% vs 23.3% vs 17.1%, respectively;  $p<0.001$ ). In terms of high-risk behaviors, the US-born NHB women had the highest prevalence of smoking in pregnancy, followed by foreign-born women with 10 and <10 years of US residence (20.5% vs 3.1% vs 1.7%, respectively;  $p<0.001$ ). The prevalence of chronic diabetes was highest in foreign-born women with <10 years of residence than in those with 10 years of residence and US-born women (4.3% vs 3.5% vs 4.1%, respectively; marginally significant at  $p=0.074$ ). A similar pattern was observed with gestational diabetes, but with US-born women having the least prevalence (8.1% vs 6.2% vs 4.9%, respectively; marginally significant at  $p=0.074$ ). Maternal stress and education level were also unfavorable for US-born women. Reports of moderate or severe stress were highest in US-born NHB women, followed by foreign-born NHB women with 10 and <10 years of US residence and (74.3% vs 70.9% vs 49.5%, respectively;  $p<0.001$ ). They were also most likely to have lower level of education (66.3% vs 51.6% vs 53.2% without college degree;  $p<0.001$ ) compared to their foreign-born counterparts with 10 and <10 years of US residence, respectively.

### **Prevalence of Preeclampsia by Duration of U.S Residence**

Preeclampsia prevalence was highest in the US-born NHB women when compared to foreign-born irrespective of the number of years of US residence. The age-adjusted prevalence of preeclampsia among NHB US-born, foreign-born with 10 years of residence and foreign-born with <10 years of residence was 12.4%, 8.8% and 8.2% respectively [Figure 3]. In the fully adjusted model, the odds of preeclampsia in foreign-born NHB

women with duration of US residence <10 years was 37% lower than in US-born NHB women (OR = 0.63; CI 0.43–0.92). In contrast, the odds of preeclampsia in foreign-born NHB women with duration of US residence ≥10 years was not significantly different from that of US-born Black women after adjusting for potential confounders [Table 4].

## DISCUSSION:

This study illustrates heterogeneity in the prevalence of preeclampsia in a large, inner-city NHB US population. The overall prevalence of preeclampsia in this study sample was 11.1%, compared to about 3.3% in Massachusetts, and about 5% in the US.<sup>2,37</sup>

The age-adjusted prevalence of preeclampsia among US-born and foreign-born NHB women was 12.4% and 9.1% respectively. While foreign-born NHB women who had been in the US for <10 years had 37% lower odds of preeclampsia compared to US-born NHB women, foreign-born NHB women with ≥10 years of stay did not have significantly different odds of preeclampsia compared to their US-born counterparts. Also, the prevalence of CVD risk factors such as obesity and smoking, was higher among US-born compared to foreign-born NHB women. Among foreign-born women, the prevalence of chronic hypertension, obesity, smoking and reports of moderate or severe stress, was higher among those with ≥10 years of US residences compared to those with <10 years of US residence. Likewise, the prevalence of preeclampsia changed with duration of residence in the US, suggesting that CVD risk factors and socioeconomic factors such as educational status and maternal stress are important indicators of overall health status.

The observed lower prevalence of preeclampsia among foreign-born women compared to their native-born counterparts is consistent with the results of some studies that have explored the association between maternal nativity and risk of hypertension in pregnancy.<sup>24–26</sup> Singh et al. found that immigrant women in most racial/ethnic groups had lower rates of maternal hypertension than their US-born counterparts. For instance, NHB immigrants had a 31% lower risk than US-born NHB.<sup>24</sup> This observation has also been documented in the risk of preterm births.<sup>27,38</sup> Elsayed et al. found that among black women in Newark, New Jersey, immigrant women had 60% lower risk of preterm births compared to their US-born counterparts after adjusting for social and behavioral variables.<sup>38</sup> This has also been documented in the prevalence of CVD risk factors such as obesity;<sup>39–41</sup> A study that used the 2000–2013 National Health Interview Survey (NHIS) data found the age-standardized prevalence of obesity to be generally lower among foreign-born women (32.8%) compared to their US-born (48.7%) NHB counterparts.<sup>39</sup>

These studies, like ours, document an epidemiological paradox -- the rates of adverse health or pregnancy outcomes, with the exception of GDM, tend to be lower among immigrant women compared to their native-born counterparts of the same race or ethnicity. This foreign-born “advantage” may partly be explained by the “healthy immigrant effect”, which posits that immigrants must inherently be healthy to be able to migrate from the sending countries into their host country.<sup>28</sup> Again, through selective immigration, immigrants tend to be more educated and are able to make healthier life choices.<sup>42,43</sup> In our sample, foreign-

born NHB women had higher levels of education, a characteristic that is expected to contribute to better pregnancy outcomes.<sup>28,44</sup>

Another reason for this foreign-born “advantage” may be protective cultural norms of immigrant women. Although not all immigrant cultures are protective, cultural norms and values such as less smoking, minimal drinking, healthier dietary preferences, as well as adequate social support may be protective for foreign-born women.<sup>29</sup> In our study, US-born black women were about 5 times more likely than foreign-born women to have smoked during pregnancy. Studies examining smoking and other health behaviors among NHB women have also made similar observations.<sup>39,45,46</sup>

The foreign-born advantage tends to diminish with increasing duration of US residence.<sup>25,30,47</sup> As demonstrated in our study, the prevalence of preeclampsia and other CVD risk factors was higher in foreign-born women with longer US residence (≥ 10 years) compared to those with shorter residence (<10 years). In the study by Elsayed et al. that explored the impact of immigration and duration of US residence on the length of gestation among black women, while recent immigrants had longer gestation compared to US-born blacks, the length of gestation for immigrants who had been in the US for at least 10 years was not different from that of the US-born women.<sup>38</sup> Additionally a recent study in a multi-ethnic immigrant population from NHIS showed that among immigrants from diverse ethnic backgrounds, longer length of residence in the US was associated with increased odds of obesity, hyperlipidemia, and cigarette smoking even after adjusting for relevant confounding factors.<sup>48</sup>

This waning of the health advantage in NHB immigrants with time may be attributed to acculturation and associated unhealthy assimilation: as foreign-born women stay longer, they adopt some aspects of the US culture such as the unhealthy diet, risky health behaviors, and sedentary lifestyle, among others, which may increase the prevalence of CVD risk factors and preeclampsia in this group.

A key message for health care professionals is that race is self-assigned and may therefore not be enough to explain the diversity within a racial group. Although the prevalence of preeclampsia has been reported to be 5%<sup>2</sup>, racial and ethnic minority groups such as NHB women are widely reported to be disproportionately affected by preeclampsia.<sup>5,49</sup> Black immigrants account for about 8.7% of the nation’s Black population.<sup>50</sup> According to the US Census bureau, by 2060, 17% of the US NHB population will be immigrants.<sup>51</sup> As this population continues to grow, we need to continue to examine the several systemic influences in maternal and pregnancy outcomes. We need to examine the impact of health inequities, implicit biases, structural racism, and disparities in access to care, maternal social support and the impact of acculturation on minority immigrants. There needs to be a framework for examining the role of these systemic and individual risk factors that influence preeclampsia. Specifically examining the role of health behaviors, environmental factors, race, and acculturation on the burden of the disease may help in the quest for effective strategies to reduce the disproportionate burden of preeclampsia on this minority population.



**Study limitations:**

The results of our study should be considered in light of some limitations. The BBC is a high-risk cohort since it oversamples women with preterm births. This may explain the high prevalence of preeclampsia reported in this study. In this study, women with preeclampsia, eclampsia and HELLP syndrome were put together in a single group due to limited sample size. Future studies with larger sample size should examine preeclampsia, eclampsia, and HELLP as separate groups to explore their shared and unique risk factors and pathogenesis. Also, one major risk factor for preeclampsia is previous pregnancy with preeclampsia.<sup>52</sup> Information on this, and other measures of social determinants of health such as employment, access to healthcare and neighborhood, were lacking in this cohort and hence not adjusted for in our analyses. We were therefore unable to explore the social determinants of health completely as our study did not capture all the different constructs such as unemployment, health care services, housing etc. Additionally, maternal race/ethnicity and place of birth were self-reported. Also, foreign-born women were from different countries, but we were underpowered to estimate the effects of specific countries of origin on the risk of preeclampsia among foreign-born women. Again, 325 of the foreign-born women did not have data on their duration of residence in the US and so were excluded in the analyses of the association between duration of US residence and prevalence of preeclampsia among foreign-born women. Finally, since the BBC is a high-risk cohort and predominantly low-income population, NHB women in this cohort may not be representative of the NHB population in the US and so generalizability of our findings may be limited.

One notable strength of this study is that the BBC is a rich source of data for studying adverse pregnancy outcomes such as preeclampsia, preterm births and low birth weight and broad array of socio-demographic and clinical risk factors.

**Conclusion:**

The findings of this study suggest that the prevalence of traditional CVD risk factors, and sex-specific risk factors namely preeclampsia are lower among foreign-born NHB women compared to US-born NHB women. Duration of residence in the US is also associated with the risk of preeclampsia among foreign-born women, with women with shorter duration of residence having a significantly lower odds of preeclampsia compared to US-born NHB women, whereas those with longer duration of residence do not have significantly different odds of preeclampsia compared to US-born NHB women. Our findings support the foreign-born advantage and the waning of this advantage with longer duration of residence. Our findings provide insight into the heterogeneity of NHB women in terms of preeclampsia risk and associated risk factors; if further confirmed, may help inform more precise risk assessment and intervention. Our findings also illustrate that preeclampsia risk can be influenced by both biological and social determinants and underscore the need of transdisciplinary research to address racial/ethnic disparity in preeclampsia and related conditions.

**Supplementary Material**

Refer to Web version on PubMed Central for supplementary material.

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## ABBREVIATIONS AND ACRONYMS

<b>ACC</b>	American College of Cardiology
<b>AHA</b>	American Heart Association
<b>BBC</b>	Boston Birth Cohort
<b>BMI</b>	body mass index
<b>CAD</b>	coronary artery disease
<b>CI</b>	confidence interval
<b>CVD</b>	cardiovascular disease
<b>GDM</b>	gestational diabetes mellitus
<b>NHB</b>	non-Hispanic Blacks
<b>OR</b>	odds ratio
<b>SDOH</b>	social determinants of health

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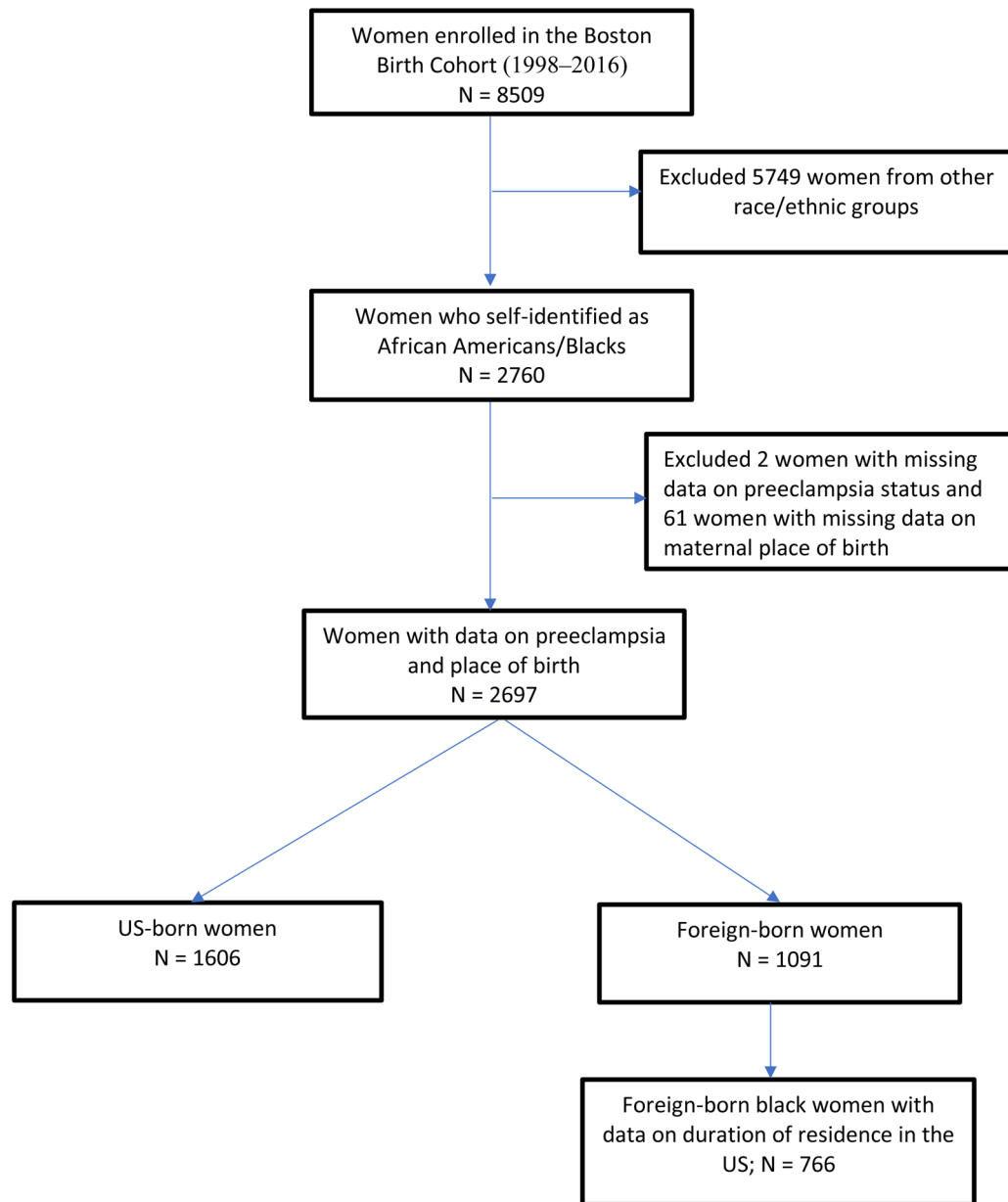
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**What is known**

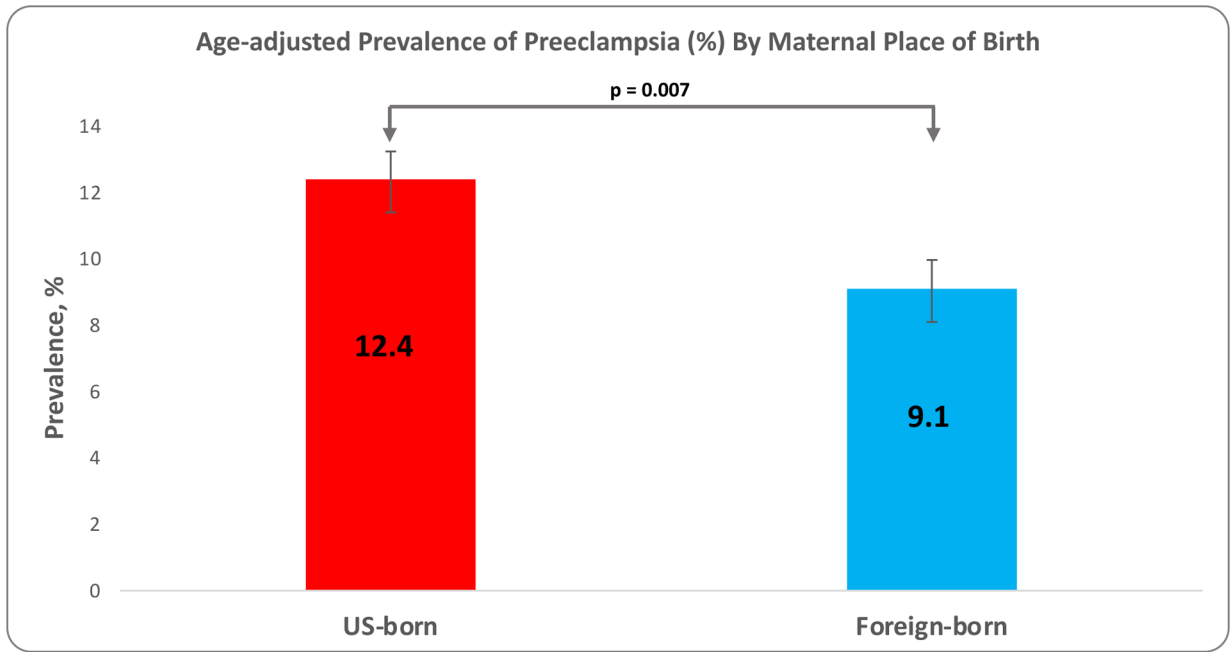
- Preeclampsia is a significant cause of maternal morbidity and mortality worldwide and in the United States, and it disproportionately affects non-Hispanic Black women.
- Not much is known about the association of maternal place of birth and duration of residence with the prevalence of preeclampsia and other cardiovascular (CV) risk factors among non-Hispanic Black (NHB) women residing in the US.

**What the study adds:**

- The prevalence of preeclampsia and other CV risk factors was higher among US- compared to foreign-born NHB women: US-born NHB women were younger, in higher percentage current smokers, had higher baseline prevalence of obesity (BMI  $\geq 30\text{Kg/m}^2$ ) and maternal stress, and the age-adjusted prevalence of preeclampsia among US- and foreign-born NHB women was 12.4% and 9.1% respectively.
- Longer duration of US residence was associated with a higher prevalence of preeclampsia and other CV risk factors among foreign-born NHB women: Foreign-born women with  $\geq 10$  years of US residence had higher prevalence of chronic hypertension, obesity, smoking and maternal stress than those with  $<10$  years of US residence, and the age-adjusted prevalence of preeclampsia among foreign-born with  $\geq 10$  years vs  $<10$  years of US residence was 8.8% and 8.2% respectively.
- This study supports the “foreign-born advantage” among NHB women and the waning of this advantage with longer duration of residence in the US

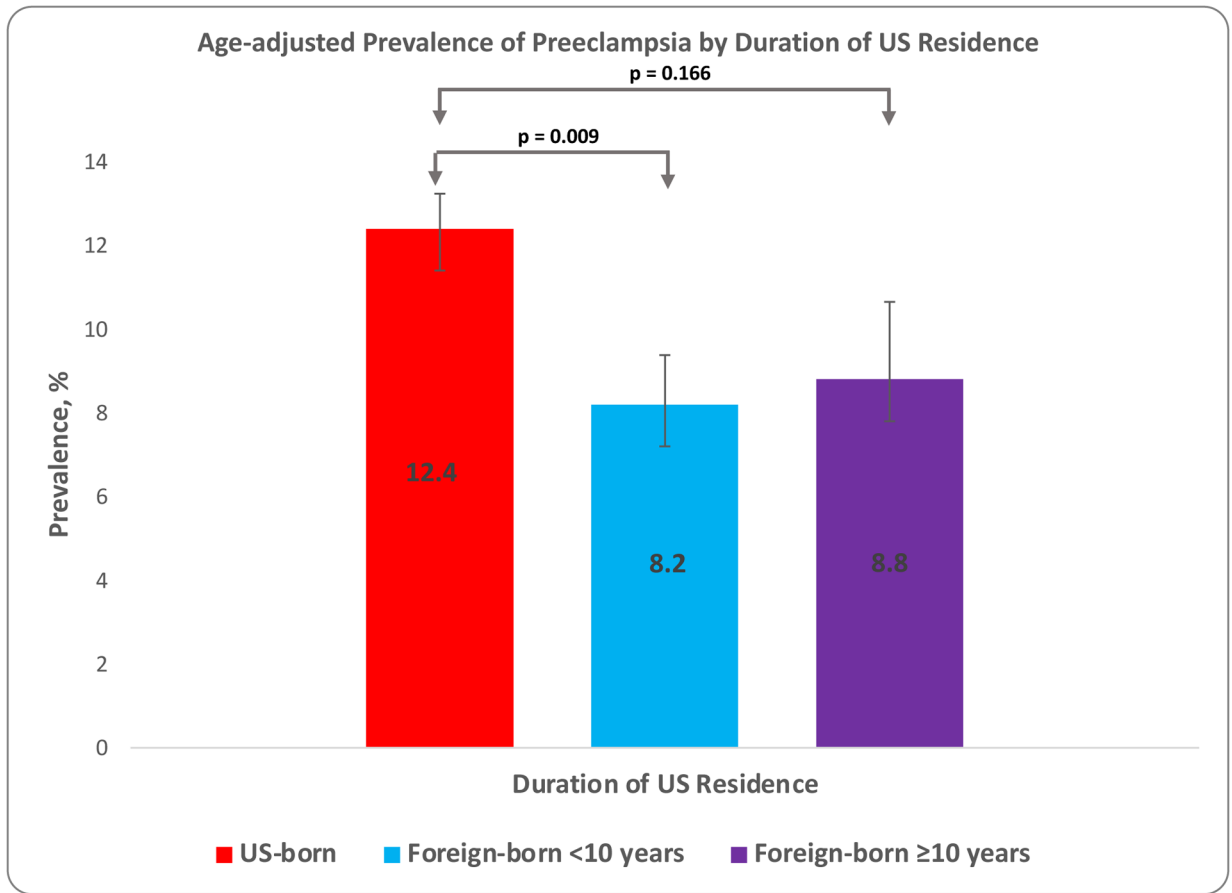


**Figure 1:**  
Flowchart of analytic population



**Figure 2:** Age-adjusted prevalence of preeclampsia by maternal place of birth





**Figure 3:**  
Age-adjusted prevalence of preeclampsia by duration of US residence

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**Table 1:**

Comparison of Maternal Characteristics by Maternal Place of Birth among Non-Hispanic Black Women in the Boston Birth Cohort (1998–2016)

Maternal characteristics	Total n = 2697 (%)	US-born n = 1606 (%)	Foreign-born n = 1091 (%)	p-value
Maternal Age at Delivery (years)				<0.001
<20	380(14.1)	299(18.6)	81(7.4)	
20–34	1923(71.3)	1142(71.1)	781(71.6)	
>34	394(14.6)	165(10.3)	229(21.0)	
Parity				0.065
0	1114(41.3)	681(42.4)	433(39.7)	
1	762(28.3)	427(26.6)	335(30.7)	
2+	821(30.4)	498(31.0)	323(29.6)	
Chronic Hypertension				0.601
No	2493(92.4)	1481(92.2)	1012(92.8)	
Yes	204(7.6)	125(7.8)	79(7.2)	
BMI (kg/m <sup>2</sup> )				<0.001
<25	1176(43.6)	694(43.2)	482(44.2)	
25.0–29.9	744(27.6)	418(26.0)	326(29.9)	
30	657(24.4)	443(27.6)	214(19.6)	
Missing	120(4.4)	51(3.2)	69(6.3)	
Diabetes Mellitus				0.025
No	2431(90.1)	1461(91.0)	970(88.9)	
Gestational	158(5.9)	78(4.9)	80(7.3)	
Chronic Diabetes	108(4.0)	67(4.1)	41(3.8)	
Smoking in index pregnancy				<0.001
No	2314(85.8)	1276(79.5)	1038(95.1)	
Yes	383(14.2)	330(20.5)	53(4.9)	
Maternal stress (general)				<0.001
mild	846(31.4)	413(25.7)	433(39.7)	
moderate	1500(55.6)	962(59.9)	538(49.3)	
severe	351(13.0)	231(14.4)	120(11.0)	
Maternal Education				<0.001
Secondary School or Less	640(23.7)	433(27.0)	207(19.0)	
GED/High School Graduate	1008(37.4)	631(39.3)	377(34.6)	
College Education/Degree	993(36.8)	509(31.7)	484(44.4)	
Missing	56(2.1)	33(2.0)	23(2.0)	

BMI – Body Mass Index

GED – General Education Development

**Table 2:**

Crude and Adjusted Odds Ratios with 95 % Confidence Intervals for Association between Preeclampsia and Maternal Place of Birth among Non-Hispanic Black Women in the Boston Birth Cohort (1998–2016)

Maternal place of birth	N	% preeclampsia	OR and 95% CI for Preeclampsia					
			Model 1 n = 2697	p-value	Model 2 n = 2697	p-value	Model 3 n = 2697	p-value
US-born	1606	12.20	REF		REF		REF	
Foreign-born	1091	9.35	0.74 [0.58 – 0.96]	0.021	0.70 [0.54 – 0.91]	0.007	0.73[0.55–0.97]	0.031

Model 1: Unadjusted Model  
 Model 2: Age-adjusted  
 Model 3: Model 2 + hypertension, parity, BMI, diabetes, education, smoking and general stress

OR – Odds Ratio

CI – Confidence Interval

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**Table 3:**

Comparison of Maternal Characteristics by Duration of Residence among Non-Hispanic Black Women in the Boston Birth Cohort (1998–2016)

Maternal characteristics	Total n = 2372 (%)	US-born n = 1606 (%)	Foreign-born with <10 years n = 539	Foreign-born with 10 years n = 227	p-value
Maternal Age at Delivery (years)					<0.001
<20	338(14.3)	299(18.6)	18(3.3)	21(9.2)	
20–34	1698(71.6)	1142(71.1)	408(75.7)	148(65.2)	
>34	336(14.2)	165(10.3)	113(21.0)	58(25.6)	
Parity					0.007
0	993(41.9)	681(42.4)	233(43.2)	79(34.8)	
1	667(28.1)	427(26.6)	171(31.7)	69(30.4)	
2+	712(30.0)	498(31.0)	135(25.1)	79(34.8)	
Chronic Hypertension					0.460
No	2187(92.2)	1481(92.2)	501(92.9)	205(90.3)	
Yes	185(7.8)	125(7.8)	38(7.1)	22(9.7)	
BMI (kg/m <sup>2</sup> )					<0.001
<25	1031(43.5)	694(43.2)	234(43.4)	103(45.4)	
25.0–29.9	652(27.5)	418(26.0)	170(31.5)	64(28.2)	
30	588(24.8)	443(27.6)	92(17.1)	53(23.3)	
Missing	101(4.2)	51(3.2)	43(8.0)	7(3.1)	
Diabetes Mellitus					0.074
No	2138(90.1)	1461(91.0)	472(87.6)	205(90.3)	
Gestational	136(5.8)	78(4.9)	44(8.1)	14(6.2)	
Chronic Diabetes	98(4.1)	67(4.1)	23(4.3)	8(3.5)	
Smoking in index pregnancy					<0.001
No	2026(85.4)	1276(79.5)	530(98.3)	220(96.9)	
Yes	346(14.6)	330(20.5)	9(1.7)	7(3.1)	
Maternal stress (general)					<0.001
mild	751(31.7)	413(25.7)	272(50.5)	66(29.1)	
moderate	1316(55.5)	962(59.9)	220(40.8)	134(59.0)	
severe	305(12.8)	231(14.4)	47(8.7)	27(11.9)	
Maternal Education					<0.001
Secondary School or Less	567(23.9)	433(27.0)	100(18.5)	34(15.0)	
GED/High School Graduate	901(38.0)	631(39.3)	187(34.7)	83(36.6)	
College Education/Degree	869(36.6)	509(31.7)	250(46.4)	110(48.4)	
Missing	35(1.5)	33(2.0)	2(0.4)	0(0.00)	

BMI – Body Mass Index

GED – General Education Development

**Table 4:**

Crude and adjusted Odds Ratios with 95 % Confidence Intervals for Association between Preeclampsia and Duration of Residence among Non-Hispanic Black Women in the Boston Birth Cohort (1998–2016)

Duration of Stay in the US	N	% with preeclampsia	OR and 95% CI for Preeclampsia					
			Model 1 N = 2372	p-value	Model 2 N =2372	p-value	Model 3 N =2372	p-value
US-Born	1606	12.20	REF		REF		REF	
Foreign-born <10 years	539	8.53	0.67[0.48–0.94]	0.020	0.63[0.45–0.89]	0.009	0.63[0.43–0.92]	0.018
Foreign-born 10 years	227	9.25	0.73[0.46–1.18]	0.199	0.68[0.42–1.10]	0.116	0.64[0.38–1.07]	0.091
Model 1: Unadjusted Model Model 2: Age-adjusted Model 3: Model 2 + hypertension, parity, BMI, diabetes, education, smoking and general stress								

OR – Odds Ratio

CI – Confidence Interval