RESEARCH ARTICLE

Application of the Healthy Migrant Theory to Maternal Morbidity and Mortality Data in Ohio

Cassidy Hughes-Lubanski[1]; Fiona Hodges[2]; Sara Paton[1]; Timothy Crawford[1,3]; David Dhanraj[2]; Keith Reisinger-Kindle[2]

[1]Department of Population and Public Health Sciences, Wright State University Boonshoft School of Medicine, Dayton, OH
[2]Department of Obstetrics and Gynecology, Wright State University Boonshoft School of Medicine, Dayton, OH
[3]Department of Family Medicine, Wright State University Boonshoft School of Medicine, Dayton, OH

Corresponding Author: Keith Reisinger-Kindle, 128 Apple Street, Suite 3800, Weber CHE, Dayton, OH 45409, (269) 929-1064. keith.reisinger-kindle@wright.edu

ABSTRACT

Background: The healthy migrant theory is a phenomenon describing a protective effect regarding specific health outcomes when a person is born outside of the United States (US). Previous literature has focused on the application of this theory to infant outcomes, leaving its application to maternal outcomes mostly unstudied. The objective of this research is to determine whether the healthy migrant theory, specifically as it applies to Black women, holds true to maternal morbidity in the Ohio population.

Methods: Birth record data from the Ohio Department of Health were analyzed from 2015-2020 that included mothers identifying as White or Black and data where country of birth was available (n=717 300). Mothers were grouped by race and nationality. Maternal morbidity and socioeconomic status were analyzed. One-way ANOVA was used to examine associations between socioeconomic status and number of maternal morbidity events. Binary logistic regression models were developed to examine the relationships among race, nationality, and occurrence of maternal morbidity events. Interaction between race and nationality was also evaluated.

Results: Among Black mothers, nationality was significantly associated with the likelihood of any maternal morbidity event occurring (OR = 1.659; 95% CI = 1.534, 1.795; p < 0.001), with foreign-born mothers having about 1.66 times greater odds of having a maternal morbidity event. This relationship persisted after adjusting for socioeconomic status. No statistical difference in low socioeconomic status indicators was found between foreign-born Black mothers and US-born Black mothers (p = 0.349, 95% CI = -0.007, 0.030).

Conclusion: Our findings appear to contradict the healthy migrant theory. More research regarding treatment and outcomes of foreign-born Black mothers must be implemented to better understand the nuances of the application of this theory to maternal outcomes. Caution should be taken when comparing infant and maternal outcomes and interventions since they may not be as closely connected as previously thought. Limitations of this project include inaccuracies in data collection from birth certificates, limited morbidity variables, and lack of stratification based on country of origin.

Keywords: Maternal and child health; Immigrant health; Health disparities; Structural racism; Logistic regression

INTRODUCTION

Over the past several years, many articles have published data demonstrating a significant difference in infant morbidity and mortality between foreign-born women living in the United States (US) and US-born women of the same racial background.[1-4] For instance, prior research has demonstrated that the incidence of low birth weight in African-born Black women in the US more closely resembled the incidence of low birth weight in US-born White women compared to US-born Black women.[2] These findings challenged the prior theories that higher incidences of infant morbidity, including low birth weight, was higher in Black populations

due to genetic effects corresponding to each population's race.[2,3] These data pointed to an alternative explanation for the differences in infant mortality between Black women and White women. Instead of citing genetics as the cause for the increased rates of infant morbidity in US-born Black women, the data suggest that these increased rates are more likely attributed to the inherent societal racism and socioeconomic status of the mentioned populations.[2] This phenomenon has become known as the healthy migrant theory; the idea that there is a protective effect in regard to specific health outcomes when a person is born outside of the US and then migrates to the US compared to a person of similar ethnicity who is born in the US.[5]

Several published research studies have demonstrated differences in mortality and outcomes between infants of US-born women and infants of immigrant women of the same ethnicity. For example, one such study demonstrated a significant difference in low birth weight between infants of US-born women of Mexican descent and infants of Mexican-born women. The data from this study found that infants of US-born Mexican Americans were found to be at 60 percent higher risk of low birth weight than infants of Mexican-born women.[6] Similar outcomes have been published for other immigrant populations, thereby demonstrating a trend that infants born to immigrant women have significantly lower incidence of poor outcomes compared to US-born women of the same ethnicity. Another research study produced data further supporting this trend, namely that there was a significantly lower rate of preterm birth and birth of SGA (small for gestational age) infants in foreign-born non-Hispanic Black women compared to US-born non-Hispanic Black women.[4] An additional article similarly outlined how the healthy migrant theory affects infant outcomes. This article analyzed preterm birth rates between US-born and foreign-born Black women. It was also found that US-born Black women had a 3.2 higher risk of preterm birth than foreign-born Black women and a 4.4 higher risk of preterm birth than US-born White women.[7]

The Ohio Department of Health listed maternal and infant health as a health outcome priority on the 2020-2022 State Health Improvement Plan, with an emphasis on improving health equity, with Black mothers experiencing disproportionately high rates of preterm birth, infant mortality, and severe maternal morbidity.[8] Based on the Ohio Department of Health's 2020 Infant Mortality Report, infant mortality is at its lowest level in over a decade, but there is a persistent race-based disparity, with Black infants dying at a rate 2.7 times greater than White infants.[9] There is a similar disparity in Ohio in both maternal mortality and maternal morbidity.[10,11] As of the 2020 US Census, 14.4% of Ohio's population identified as Black or Black and another race. From 2016 to 2019, non-Hispanic Black mothers in Ohio have a severe maternal morbidity rate more than double that of non-Hispanic White mothers in Ohio.[10] Additionally, from 2008 to 2016, pregnancy-related deaths in Ohio were significantly higher for non-Hispanic Black mothers at 29.5 deaths per 100 000 live births compared to 11.5 deaths for

non-Hispanic White mothers.[11] This reveals a significant health care burden, with Black citizens experiencing a disproportionate number of negative health outcomes. Understanding how demographic factors like race and immigrant status interact and relate to health outcomes in Ohio is necessary to develop effective strategies to eliminate health disparities and improve health outcomes.

As described above, previous researchers have investigated infant morbidity and mortality outcomes as they relate to the healthy migrant theory, however, there has been substantially less research examining maternal morbidity and mortality outcomes. The goal of this research is to investigate whether the healthy migrant theory holds true for maternal morbidity in the Ohio population, specifically for Black mothers.

METHODS

Sample

This analysis used deidentified birth record data for the state of Ohio accessed from the Ohio Department of Health's Vital Statistics. The protocol for this study was submitted to the Ohio Department of Health institutional review board and found to be exempt. Complete data from the years 2015-2020 were included. All cases included in the statistical analysis were single parity births that occurred in mothers who were residents of Ohio and gave birth in the state (n= 767 254). This study focused on a subset of cases composed of US-born White mothers, US-born Black mothers, and foreign-born Black mothers (n= 693 321), excluding foreign-born White mothers and mothers of other race/ethnicities from the analysis sample. These 2 populations were excluded because the main focus was among Black mothers specifically.

Measures

Race. The mother's race was determined by the Vital Statistics race category coded for the Public Information Warehouse, with possible options of White, Black, Native American, Asian, Pacific Islander/Hawaiian, or Other/Unknown. Analysis focused on White and Black mothers. Mother's ethnicity was not evaluated.

Mother's Nationality. Nationality was evaluated as a binary categorical variable of US-born mothers and foreign-born mothers. Foreign-born mothers included any mother born in a known country that was not the US. Unknown countries of birth were marked as missing.

Group by Race and Nationality. A combined group variable was created with mothers separated into 3 group designations: US-born White mothers, US-born Black mothers, and foreign-born Black mothers.

Maternal Morbidity. Maternal morbidity events included perineal laceration, ruptured uterus, unplanned hysterectomy, admission to intensive care, unplanned operation, maternal transfusion, and hypertension eclampsia. Two separate variables were created to evaluate maternal morbidity as a combined variable for analysis. The first variable was a binary categorical variable with options

for no maternal morbidity event occurred or any maternal morbidity event occurred. The second combined variable was a numeric variable of the number of maternal morbidity events that occurred (possible values of 0-7, with 0 meaning no maternal morbidity, and 7 meaning all the maternal morbidity events were met).

Socioeconomic Status. Proxy measures were used to evaluate socioeconomic status. Mothers were identified as low socioeconomic status if they met at least 1 of the following criteria: payment method was self-pay or Medicaid, the mother completed less than a high school education, or the mother received WIC services. This created a binary socioeconomic status variable (low socioeconomic status or not low socioeconomic status). These proxy measures serve as conservative estimates of mothers that would fall into the low socioeconomic status category.

Analysis

Data processing and statistical analysis was conducted using IBM SPSS (version 29). Demographic characteristics were determined, including frequencies of mother's race, nationality, age, education level, payment source, and WIC use (Tables 1 and 2). In the event of missing data, cases were deleted.

Differences in the number of maternal morbidity events that occurred were evaluated based on the mother's race and nationality group (US-born White, US-born Black, and foreign-born Black) using one-way ANOVA. Post-hoc analyses were conducted using the Games-Howell test.

Binary logistic regression models were used to evaluate the effect of the mother's race and nationality (groups for US-born White, US-born Black or foreign-born Black mothers) on the occurrence of any maternal morbidity events and evaluate the effect of nationality on the occurrence of any maternal morbidity events among Black mothers (n=141 267). Unadjusted and adjusted relationships were investigated. Each model adjusted for socioeconomic status (low socioeconomic status) and the number of prenatal care visits.

RESULTS

The study sample included 717 300 singleton births occurring from 2015 to 2020 in Ohio among White mothers and Black mothers. Mother's age ranged from 11 to 59 years, with a mean age of 28.07 years (SD = 5.60). There were 43 237 cases where the mother was born in a country other than the US. Despite Black mothers

only accounting for 17.8% of births among mothers born in the US in the sample, 44.5% of the births among foreign-born mothers involved Black mothers (Table 1).

The subset of cases for analysis included cases only from US-born White mothers, US-born Black mothers, and foreign-born Black mothers (n= 693 313). Maternal morbidity events were rare, with 1 or more of the 7 maternal morbidity events occurring in only 2.5% of US-born White mothers, 2.6% of US-born Black mothers, and 4.2% of foreign-born Black mothers. The most prevalent maternal morbidity outcome was third-degree or fourth-degree perineal laceration, which occurred in less than 2% of cases. Additional demographic characteristics are available in Table 2, and maternal morbidity outcomes are listed in Table 3.

A one-way ANOVA was performed comparing the effects of mother's race and nationality group on maternal morbidity. This test revealed that there was a statistically significant difference in the number of maternal morbidity factors between mother groups ($F (2, 693 313) = 106.125$, $p < 0.001$) (Table 3). Post hoc test revealed that the mean number of maternal morbidity events was significantly different between foreign-born Black mothers and US-born Black mothers ($p < 0.001$, 95% CI = 0.014, 0.022), with foreign-born Black mothers having a greater number of maternal morbidity events, on average (0.05), than US-born Black mothers (0.03). Additionally, the mean number of maternal morbidity events was significantly different between foreign-born Black mothers and US-born White mothers ($p < 0.001$, 95% CI = 0.016, 0.024), with foreign-born Black mothers having a greater number of maternal morbidity events, on average (0.05), than US-born White mothers (0.03).

An unadjusted binary logistic regression was performed to evaluate the influence of the mother's race and nationality group on the odds of having any maternal morbidity event (n= 693 313). The mother's race and nationality were significantly associated with having a maternal morbidity event ($p < 0.001$). Compared to US-born White mothers, foreign-born Black mothers had about 1.7 times greater odds of having a maternal morbidity event (Odds Ratio (OR) = 1.716; 95% CI = 1.597, 1.845; $p < 0.001$). Additionally, compared to US-born Black mothers, foreign-born Black mothers had 1.6 times greater odds of having any maternal morbidity event (OR = 1.658; 95% CI = 1.534, 1.795; $p < 0.001$). However, the odds of having any maternal morbidity event were not significantly different between US-born White mothers and US-born Black mothers (OR = 1.034; 95% CI = 0.994, 1.076; $p = 0.092$).

Table 1. Frequency of Cases by Mother's Race and Nationality

		Mother's nationality		
		US-born	Foreign-born	Total
Mother's race	White	553 654 (82.14)	23 979 (55.46)	577 633 (80.53)
	Black	120 409 (17.86)	19 258 (44.54)	139 667 (19.47)
	Total	674 063 (100)	43 237 (100)	717 300 (100)

After adjusting for socioeconomic status and number of prenatal care visits, mother's race and nationality group was significantly associated with having a maternal morbidity event (p < 0.001). Holding socioeconomic status and number of prenatal care visits constant, foreign-born Black mothers have about 2 times greater odds of having a maternal morbidity event than US-born White mothers (OR = 2.002; 95% CI = 1.857, 2.158; p < 0.001), and foreign-born Black mothers have about 1.2 times greater odds of having a maternal morbidity event than US-born Black mothers (OR = 1.223; 95% CI = 1.173, 1.276; p < 0.001).

Among Black mothers, (n = 139 667), nationality was significantly associated with any maternal morbidity event occurring (OR = 1.659; 95% CI = 1.534, 1.795; p < 0.001), with foreign-born mothers having about 1.66 times greater odds of having a maternal morbidity event. This relationship persisted after adjusting for socioeconomic status (OR = 1.644; 95% CI = 1.519, 1.779; p < 0.001).

DISCUSSION

The results from this analysis confirm what has previously been demonstrated regarding the significant difference in maternal morbidity in Black mothers compared to White mothers, with Black mothers experiencing more maternal morbidity than White mothers. When comparing immigration status, our study demonstrated that immigrant mothers had a statistically significant increased number of maternal morbidity events than US-born mothers. Additionally, immigrant mothers also had a significant mean number of low socioeconomic status indicators compared to US-born mothers. These findings are specifically important because in other studies throughout the US, there are often findings that demonstrate that Black immigrant mothers have improved pregnancy outcomes.[12]

The current study also demonstrated that when comparing Black immigrant mothers to US-born Black mothers, Black immigrant mothers had a great number of maternal morbidity events. When compared to US-born White mothers, Black immigrant mothers

again demonstrated a greater number of maternal morbidity events. In a similar outcome, Black immigrant mothers had a higher number of indicators for low socioeconomic status compared to US-born White mothers. However, there was not a statistically significant difference in indicators for low socioeconomic status between Black immigrant mothers and US-born Black mothers.

These outcomes are contradictory to the hypothesis that the healthy migrant theory proposes, specifically that US-born Black mothers would be predicted to have more maternal morbidity events compared to Black immigrant mothers. There are a few other studies that have analyzed specific maternal outcomes that have supported this healthy migrant theory when applied to Black mothers. One such study analyzed the prevalence of preeclampsia, which was demonstrated to be higher in US-born versus foreign-born non-Hispanic Black women. This study also interestingly analyzed how duration living in the US affected the health of foreign-born Black mothers, demonstrating that foreign-born Black women with more than 10 years of living in the US had a higher prevalence of chronic hypertension, obesity, smoking, and maternal stress.[13] Our investigation did not include information on length of time living in the US as this information is not available on birth records, a potential limitation of the study which may partially explain why our results do not corroborate the healthy migrant theory.

Given that the data in this research project demonstrate a significant increase in maternal morbidity in Black immigrant mothers compared to US-born Black mothers, further evaluation and research regarding treatment and outcomes of Black immigrant mothers must be implemented. Implicit bias has been discussed as one of the etiologies behind the discrepancy in maternal outcomes in Black mothers versus White mothers in the US. Prior research has been performed which outlines implicit bias and how it can impact the care that Black women receive.[14] Using this information, implicit bias could potentially be implicated as one reason why the Ohio Department of Health data in this research demonstrated an increase in maternal morbidity in Black immigrant

Table 2. Demographic Characteristics of Ohio Residents with Singleton Births in the State of Ohio from 2015-2020 by Race and Nationality

		US-born White mothers	US-born Black mothers	Foreign-born Black mothers
Mother's average age (years)		28.39	26.21	30.49
Mother's education (n, %)				
	Less than high school	59 815 (10.82)	22 243 (17.73)	4339 (23.0)
	High school graduate/ GED	142 787 (25.82)	46 394 (38.72)	5833 (30.91)
	Some college	159 704 (28.88)	40 747 (34.0)	4699 (24.9)
	Bachelor's degree	120 416 (21.78)	7666 (6.40)	2729 (14.46)
	Graduate degree	70 209 (12.7)	3783 (3.16)	1269 (6.73)
Payment source (n, %)				
	Medicaid	185 902 (33.75)	88 702 (73.96)	12 693 (66.23)
	Private insurance	322 681 (58.59)	26 100 (21.76)	4441 (23.17)
	Self-pay/uninsured	25 998 (4.72)	2113 (1.76)	1259 (6.57)
	Other	16 193 (2.94)	3014 (2.51)	773 (4.03)
Mother used WIC (%)		27.18	55.21	52.13

mothers. Since implicit attitudes are thoughts that exist outside of conscious awareness, they can be difficult to control and can often go unrecognized.[15] Societies have also created and fostered racial discrimination throughout history by reinforcing inequitable systems such as housing, education, health care, and employment. These inequitable systems have then reinforced existing racial discrimination, creating an endless cycle of oppression and persecution.[16] This can specifically be seen in health care, where both perceived and actual racism have been shown to cause a measurably increased incidence in poor outcomes between Black persons versus White persons.[14,15,17,18] In the US, there has also been historically a great deal of discrimination toward immigrants stemming from a variety of factors including but not limited to stereotypes, perceived threat and competition, and the ideological climate. Political viewpoints often use stereotypes of immigrants to support restrictive immigration policies, further perpetuating this discrimination and solidifying the implicit bias toward immigrants.

Limitations of this project include limitations and inaccuracies of data available on birth certificates. Data variables for analysis were limited to what was available on birth record data, and maternal morbidity events may have been present that were not included in the birth records. In addition to this, results should be interpreted with caution as there may be uncontrolled confounding. These are inherent limitations related to the retrospective approach of the study. This study could not include the length of residence in the US for the women who identified as foreign born as this information was not available. However, length of time living in the US has been shown to be related to increased risk of maternal morbidity outcomes.[13] Another limitation was the lack of analysis by maternal age or number of pregnancies. Additionally, this investigation did not include a stratification of outcomes based on specific country of origin. The results may not be generalizable to mothers who do not identify as Black or non-Hispanic

White as the study included only mothers who identified as Black or non-Hispanic White. Although a woman identifies as a foreign-born Black mother, these women should not be treated as a homogenous group since the unique country of origin likely contributes unique barriers and attributes that could affect maternal outcomes.

From 2004 to 2013, Ohio welcomed 18 261 refugees from 54 different countries, with the greatest number of refugees immigrating from Somalia (5712).[19] A 2018 study looking at maternal and reproductive health care access among Somali refugees in Ohio found unique barriers to care. Despite the majority of the Somali refugee women being employed, married, and having completed primary education, about half of the women in the study were living below the poverty line, a quarter of the women were uninsured, and the majority had no or limited English proficiency. Additionally, more than 80% of study respondents had experienced female genital circumcision. The most frequently cited reason to avoid or postpone maternal and reproductive care among the refugee women was a lack of insurance coverage.[20] Thus, the additional socioeconomic, language, and cultural barriers to access maternal health care among refugee immigrant populations could further explain the high maternal morbidity in Black immigrant mothers in Ohio, compared to Black immigrant populations in other communities with different refugee populations.

Future directions for this project could include further analysis of morbidity outcomes for foreign-born English-speaking women versus foreign-born non-English speaking women to determine how language barriers affect such outcomes. Further analysis could be done to examine how differences may exist among foreign-born White mothers as well, given that this population was not included in this study. As mentioned above, length of time living in the US was not evaluated. Given that other studies have demonstrated a correlation between negative outcomes and

Table 3. Clinical Outcomes for Ohio Residents with Singleton Births in the State of Ohio from 2015-2020 by Race and Nationality

	US-born White mothers	US-born Black mothers	Foreign-born Black mothers
Route of delivery, n = 693 109	n = 553 498	n= 120 358	n= 19 253
Spontaneous	367 227 (66.35)	78 601 (65.31)	12 324 (64.01)
Forceps	6738 (1.22)	1413 (1.17)	279 (1.45)
Vacuum	19 065 (3.44)	3270 (2.72)	635 (3.30)
Cesarean	160 468 (28.99)	37 074 (30.80)	6015 (31.24)
Hypertension eclampsia, n = 693 321	1340/553 654 (0.24)	401/120 409 (0.33)	42/19 258 (0.22)
Maternal transfusion, n = 693 313	2725/553 649 (0.49)	1133/120 409 (0.94)	182/19 255 (0.95)
Perineal laceration (3rd degree or 4th degree), n = 693 313	6443/553 649 (1.16)	682/120 409 (0.57)	381/19 255 (1.98)
Ruptured uterus, n = 693 313	163/553 649 (0.03)	67/120 409 (0.06)	38/19 255 (0.20)
Unplanned hysterectomy, n = 693 313	248/553 649 (0.04)	88/120 409 (0.07)	20/19 255 (0.10)
Admit to intensive care, n = 693 313	990/553 649 (0.18)	325/120 409 (0.27)	79/19 255 (0.41)
Unplanned operation, n = 693 313	3346/553 649 (0.60)	843/120 409 (0.70)	167/19 255 (0.87)
Maternal morbidity (number of events), n = 693 313	0.028 ± 0.182	0.029 ± 0.193	0.047 ± 0.240
Maternal morbidity (any event), n = 693 313	13 899/553 649 (2.51)	3124/120 409 (2.59)	815/19 255 (4.23)

Data for continuous variables are displayed: mean ± SD, and data for categorical variables are displayed: frequency (%).

length of time living in the US, it would be prudent to investigate if this correlation also exists for the Ohio population examined in this study as this could give insight into the negative effects of assimilation.[12,13] Additionally, research could be done to compare maternal morbidity outcomes in foreign-born Black women versus foreign-born non-Black women to demonstrate the effect that race has on maternal outcomes. Outside of future research, the data from this project demonstrates a significant difference in outcomes for Black immigrant women versus US-born Black women, therefore further education and application of mindful medicine should be implicated. This could include standardizing health and equity morbidity, mortality, and improvement conferences for every hospital and residency program to create a platform to discuss the implications of race and background in medicine. Additionally, it would be recommended that forums for health care providers to discuss their implicit biases in a constructive manner be created for hospitals in the US.

PUBLIC HEALTH IMPLICATIONS

Race-based disparities in maternal and infant birth outcomes are persistent. Based on the Centers for Disease Control and Prevention's *Morbidity and Mortality Weekly Report* (MMWR) released in 2019, from 2007-2016 in the US, Black women experience an average of 41 pregnancy related deaths per 100 000 live births, compared to an average of 13 deaths in White women. It was suggested that this disparity may arise from differences in access and quality of care or differences in the prevalence of chronic diseases.[21] Access and quality of health care is determined in part by historical, structural factors that have resulted in the under-allocation of community resources in low-income and minority communities. Additionally, these differences may also reflect additional structural implicit bias of health care providers. Identifying the root causes of race-based health disparities and the systemic causes that could be addressed through training and policy changes to address systemic and structural racism in the health care system is important.

CONFLICTS OF INTEREST

The authors have none to report.

Author Contribution
Fiona Hodges: study design, protocol draft, manuscript drafting/editing
Cassidy Hughes-Lubanski: study design, protocol draft, data analysis, manuscript drafting/editing
Sara Paton: study design, protocol draft, IRB coordination, data request/collection, data analysis, manuscript drafting/editing,
Timothy Crawford: data analysis, manuscript drafting/editing
David Dhanraj: study design, manuscript drafting/editing
Keith Reisinger-Kindle: study design, protocol draft, IRB coordination, data request/collection, data analysis, manuscript drafting/editing, senior/supervising author

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