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Healthy Immigrant Effect: Preterm Births Among Immigrants and Refugees in Syracuse, NY

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Abstract *Objectives* The healthy immigrant effect is the phenomenon by which immigrants experience more positive health outcomes than the native-born population in developed countries. The strength of this effect appears to be related to country of origin, health outcome, healthcare and integration policies of receiving countries, as well as immigration class. This secondary analysis of birth records examines whether immigrants and mothers from refugee countries have lower adjusted risk of preterm births than US-born mothers in Syracuse, NY, a preferred refugee resettlement area. *Methods* This secondary analysis included 6354 electronic birth records for residents in the city of Syracuse, NY who gave birth to singleton infants between 2009 and 2011. Multivariate log-binomial regression was used to calculate the adjusted relative risk for preterm birth among foreign-born mothers and mothers from refugee countries, compared to US-born mothers. *Results* Infants born to both foreign-born women and to women from refugee countries had decreased risks of being born preterm compared to infants born to US mothers, controlling for race, late/no prenatal care, maternal age less than 18 years and smoking. *Conclusion* Our findings support a healthy immigrant effect for preterm births both among all foreign-born immigrants and among the subsample of women from refugee countries. Mother's nativity is likely a proxy for unmeasured factors (e.g., prenatal stress, maternal diet, etc.) that may explain the relationship between mother's nativity and preterm births. Additional research is needed to better understand the underlying factors.

Keywords Preterm birth · Risk and protective factors for preterm birth · Healthy immigrant effect · Immigrants and refugees · Foreign-born birth outcomes

Significance

Mother's nativity is likely a proxy for unmeasured factors (e.g., prenatal stress, maternal diet, etc.) that may explain the relationship between mother's nativity and preterm births. Additional research is needed to better understand the underlying factors.

Introduction

Numerous studies have found "the healthy immigrant effect" or that immigrants experience superior health outcomes compared to native-born individuals from developed countries. This finding applies to a variety of health domains: overall mortality rate, mental health, obesity, and perinatal outcomes such as infant mortality and the incidence of low birth weight and preterm infants [1–5]. The healthy immigrant effect is paradoxical because many immigrants (i.e., people who have citizenship in one

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country but who enter a different country to set up permanent residence) have low socio-economic status which, in developed countries, is associated with less healthy lifestyles, fewer health-promoting behaviors, and less access to primary care [6]. Therefore, one might expect that immigrant mothers would experience adverse birth outcomes more often than their native-born counterparts. However, the majority of the literature shows the opposite pattern [2, 3]. In this study, we examine whether the healthy immigrant effect applies to preterm birth in a sample of foreign-born women with a large estimated percentage of refugees.

Refugees are individuals who are unable or unwilling to return to their country of nationality because of persecution or a well-founded fear of persecution due to their race, religion, nationality, membership in a particular social group, or political opinion and who have been granted refugee status by the host country [7]. Refugees are a subgroup of immigrants that would seem to be at greatest risk for poor birth outcomes. In addition to economic deprivation, many refugees have experienced adverse physical and mental effects associated with war, political and sectarian violence, persecution and displacement in their home countries [8]. Results of studies that examine whether the healthy immigrant effect exists in refugee populations are mixed. Some studies have not supported the presence of the healthy immigrant effect among refugees: Ethiopian refugees had similar rates of low birth weight infants as the US-born African American population [9]; Southeast Asian refugees had higher rates of low birth rate than US-born women [8]. Other studies support the healthy immigrant effect among refugees: women from the former Yugoslavia had marginally fewer preterm births and significantly fewer small for gestational age infants compared to US-born White women [10]; Cambodian refugee women had a lower incidence of low birth weight infants and lower infant mortality [11].

In 2009, a systematic review of published literature was conducted to compare birth outcomes between immigrants and native-born residents of western industrialized countries [12]. Eleven studies analyzing preterm birth were included in the meta-analyses. Preterm birth outcomes of migrant women, compared to native-born women in receiving countries were worse in 36.4 %, better in 45.5 %, and no different in 18.2 % of examined reports [12]. Collectively, the literature on perinatal health outcomes, and particularly preterm birth, suggests that there is no consensus on whether immigrant and refugee women have better birth outcomes. The literature also suggests that the healthy immigrant effect on birth outcomes may vary, depending upon country of origin, type of birth outcome, as well as healthcare and integration policies of the receiving countries [12].

Rationale for the Current Study

A growing number of refugees are relocating to the US, many of whom are from politically- and economically-unstable countries. However, little has been published about the health experiences of refugees resettling into the US, including perinatal outcomes. Of the studies that have been conducted, findings are contradictory. The healthy immigrant effect is an important phenomenon to study within the city of Syracuse for a number of reasons. First, Syracuse is classified by the Office of Refugee Resettlement as a preferred community for refugee resettlement due to the availability of jobs, affordable housing, receptivity of the local community, specialized services, and the strength of the local agencies including Catholic Charities of Onondaga County and Interfaith Works. Additionally, many foreign-born individuals (immigrants and refugees) currently live there. According to the 2007–2011 American Community Survey, over 15,000 foreign-born individuals live in Syracuse and they comprise 10.5 % of the total population [13].

Second, there is evidence of socio-economic differences between the foreign-born and native-born population in Syracuse. The foreign-born population reported lower median earnings over the last year ($29,081.00 vs. $34,742.00) and a higher percentage of individuals below 100 % of the poverty level (37.7 vs. 31.6 %) than the US-born population [14].

Third, refugee resettlement brought over 202,763 individuals to the US between 2009 and 2011 [15]. Of those refugees, 2932 were resettled in Syracuse, NY. The top ten countries of origin among refugees who resettled in Syracuse during that time period include Bhutan, Burma, Somalia, Iraq, Democratic Republic of the Congo, Eritrea, Sudan, Cuba, Burundi and Ethiopia (Table 1). Furthermore, the electronic birth record dataset used in the current study indicates that 60 % of the foreign-born infants in Syracuse, NY were born to mothers from countries with the highest refugee resettlement rates in Syracuse, NY (Table 1). Therefore, it is likely that much of the foreign-born population in our sample is comprised of refugees.

Study Hypotheses

This study seeks to expand our knowledge about preterm births in Syracuse, NY, in a sample of foreign-born women. First, we examined whether there is a greater incidence of preterm births among US-born mothers than among infants born to foreign-born mothers. We hypothesized that the healthy immigrant effect would reduce the incidence of preterm births to immigrant and refugee mothers in Syracuse. Second, this study examined maternal risk and protective factors for preterm births. Based on

Table 1 Countries with the highest refugee resettlement rates in Syracuse and the number and percentage of infants born to foreign-born mothers by maternal country of birth

Refugees resettled in Syracuse between 2009 and 2011		Infants born to foreign-born mothers in sample between 2009 and 2011	
Country of origin	Number	Number	Percent (%)
Bhutan	946	43	4
Burma	912	140	14
Somalia	401	112	12
Iraq	264	16	2
Democratic Republic of the Congo	112	9	1
Eritrea	91	2	0
Sudan	29	41	4
Cuba	26	51	5
Burundi	23	8	1
Ethiopia	16	6	1
Ukraine	15	6	1
Central African Republic	14	0	0
Liberia	13	25	3
Afghanistan	10	1	0
Rwanda	10	8	1
China	9	36	4
Vietnam	8	59	6
Mauritania	7	3	0
Iran	6	0	0
Palestine	5	9	1
Subtotal	2917	575	60
All other countries	15	391	40
Total	2932	966	100

literature reviews [16, 17], we hypothesized that mother's substance use (i.e., smoking, drug and alcohol use), low socio-economic status, presence of a sexually transmitted infection, late or non-existent prenatal care, paternal involvement, and early teenage childbearing would be associated with higher rates of preterm births. Third, we examined whether maternal nativity and refugee status are significantly associated with preterm births after controlling for other significant factors. We hypothesized that foreign maternal nativity and refugee status would be associated with lower incidence of preterm births after controlling for other significant predictors of preterm births.

Methods

The dataset for this secondary analysis consisted of 6354 electronic birth records of singleton infants born to Syracuse residents between 2009 and 2011. Multiple births (e.g., twins) were excluded from this analysis due to the high correlation between preterm births and multiple births [18]. These data included 966 infants born to foreign-born mothers, 575 of whom were from countries of origin for refugees living in Syracuse and 5388 infants born to US-born mothers.

Each birth record contained a clinical estimate of gestational age at birth, which was used to derive the binary (Y/N) outcome variable, preterm birth status. Infants born before 37 weeks of completed gestation were classified as preterm, based on the WHO definition [19]. The files also included covariate data about maternal risk factors such as alcohol or drug use (Y/N), smoking cigarettes during the first trimester of pregnancy (Y/N), any diagnosis of gonorrhea, syphilis or bacterial vaginosis during the pregnancy (Y/N), and late/no prenatal care (mother received no prenatal care or first obtained care during her last trimester). Demographic information was also included: mothers' country of birth, the primary factor (dichotomized as US- or foreign-born), mother's race (categorized as White, Black or Hispanic and Other), mother's age (dichotomized as 17 years old or younger or 18 years and older), and an

indicator of low socio-economic status (Medicaid insurance or prenatal care at public clinics). The electronic birth records also included information about paternal involvement. Births where the parents were either married or paternity was acknowledged were considered an indicator of higher paternal involvement and better maternal support than births where the parents were unmarried and paternity was not acknowledged.

Descriptive analyses were conducted to characterize the entire sample and χ^2 tests of independence were used in order to compare the characteristics of foreign- and US-born mothers. Separate bivariate log-binomial regressions were used to determine which variables were significantly associated with preterm births. Significantly associated covariates that were not highly correlated with other variables were then entered simultaneously into the final multivariate log-binomial regression model, with preterm births as the binary outcome and maternal nativity as the main factor of interest. The regression model was then used to compare preterm births among US-born mothers versus a subset of foreign-born mothers from countries that comprise a large amount of the refugee population in Syracuse. The regression model was also applied to a subgroup of foreign-born women from countries in Asia and sub-Saharan Africa. All statistical analyses were conducted using SPSS version 22.0 [20]. All statistical tests and interval estimates were carried out with a priori $\alpha = 0.05$ (two-tailed). The study was conducted under exempt status granted by the Syracuse University Institutional Review Board and in accordance with prevailing ethical research practices.

Results

Out of the 6354 singleton infants in the sample, 504 infants (7.9 %) were born preterm. Fifty preterm infants (5.2 %) were born to foreign-born mothers and 454 preterm infants (8.4 %) were born to US-born mothers ($p < 0.001$). For comparison, the rate of singleton preterm births for the US during the same period (2009–2011) was 10.3 % [21].

Table 2 provides information about maternal characteristics of the total sample and compares foreign- and US-born mothers on those characteristics. A significantly greater percentage of foreign-born mothers are of lower socio-economic status and had late or no prenatal care (Table 2). Foreign-born mothers and mothers from refugee countries are also older, are more likely to be Black or Hispanic or Other race/ethnicity, are less likely to be below 18 years of age, have lower rates of sexually transmitted infections, and are less likely to use alcohol, drugs, or smoke during pregnancy (Table 2). Table 3 shows the number and percentage of foreign-born mothers by

regional sub-groups classified by the United Nations. Relative risks, which indicate the strength of association between each maternal characteristic and preterm birth, are presented in Tables 4 and 5. Maternal characteristics that are associated with increased risk for preterm births include Black or Hispanic race/ethnicity (compared to White race), third trimester entry to prenatal care or no prenatal care, sexually transmitted infections, being younger than 18 years old at delivery, low socio-economic status, and smoking, drinking alcohol or using drugs during pregnancy. Having a foreign-born mother or a mother from a refugee country and paternal involvement are associated with lower risk of preterm birth.

In the final multivariate log-binomial regression model (Table 4), the adjusted relative risk of preterm birth was significantly lower among foreign-born mothers, compared to US-born mothers (ARR = 0.67, 95 % CI 0.49–0.89, $p = 0.007$). Thus, we observed a healthy immigrant effect in this sample after controlling for the following significant covariates: mother's race/ethnicity, late or no prenatal care, young maternal age, and smoking during the first trimester. Table 4 displays the multivariate adjusted relative risks for preterm births.

A separate multivariate log-binomial regression model (Table 5) also indicated that the adjusted risk of preterm birth was significantly lower among women who originated from countries that comprise a large amount of the refugee population in Syracuse, compared to US-born mothers (ARR = 0.61, 95 % CI 0.41–0.90, $p = 0.01$). This finding suggests that the healthy immigrant effect was present among the women from refugee countries, after controlling for significant covariates (Table 5).

The majority (77 %) of the foreign-born population in the current study originates from countries in sub-Saharan Africa and Asia, regions whose immigrants tend to have higher rates of preterm births [22, 23]. Stratified analysis revealed that the likelihood of preterm birth in Syracuse was significantly lower among sub-Saharan African and Asian foreign-born women than among US-born mothers (ARR = 0.73, 95 % CI 0.53–1.01, $p = 0.05$).

Discussion

Our study indicates that infants born to foreign-born women and women from refugee countries in Syracuse, NY during the study timeframe were nearly half as likely to be preterm, compared to infants born to US-born mothers. Our research supports the healthy immigrant effect in a foreign-born population that is comprised largely of refugees, and is consistent with some previous findings. The previously mentioned meta-analysis noted that preterm births among immigrants to industrialized countries was

Table 2 Sample characteristics for foreign-born, mothers from refugee countries and US-born mothers

Maternal characteristics	Mother from refugee country (N = 575)	Foreign-born mother (N = 966)	US-born mother (N = 5388)	Total (N = 6354)
Age (years) [M (SD)]	28.25 (6.05)***	28.26 (6.07)**	25.66 (6.19)	26.06 (6.24)
Race/ethnicity				
White	16 (2.8 %)***	97 (10.0 %)***	2411 (44.8 %)	2508 (39.5 %)
Black or Hispanic	233 (40.5 %)	338 (35.0 %)**	2129 (39.5 %)	2467 (28.8 %)
Other/mixed races	326 (56.7 %)***	531 (55.0 %)***	847 (15.7 %)	1378 (21.7 %)
Paternal involvement[a]	537 (93.4)***	889 (92 %)***	3794 (70.4 %)	4683 (73.7 %)
Late or no prenatal care[b]	41 (7.1 %)**	66 (6.8 %)**	246 (4.6 %)	312 (4.9 %)
Sexually transmitted infection[c]	94 (16.3 %)***	153 (15.8 %)***	1427 (26.5 %)	1580 (24.9 %)
Drank alcohol	2 (0.3 %)*	2 (0.2 %)**	77 (1.4 %)	79 (1.2 %)
Used drugs	1 (0.2 %)***	4 (0.4 %)***	566 (10.5 %)	570 (9 %)
Low socioeconomic status[d]	506 (88 %)***	752 (77.8 %)[†]	4034 (74.9 %)	4786 (75.3 %)
Less than 18 years old	6 (1.0 %)***	14 (1.4 %)***	310 (5.8 %)	324 (5.1 %)
Smoked 1st trimester	6 (1.0 %)***	21 (2.2 %)***	1533 (28.5 %)	1554 (24.5 %)

* Difference between foreign-born mothers or refugee mothers and US-born mothers is significant at $p < 0.05$

** Difference between foreign-born mothers or refugee mothers and US-born mothers is significant at $p \leq 0.01$

*** Difference between foreign-born mothers or refugee mothers and US-born mothers is significant at $p \leq 0.001$

[†] Difference between foreign- born mothers or refugee mothers and native-born mothers is marginal at $p = 0.057$

[a] Parents were either married or paternity was acknowledged

[b] First prenatal care in third trimester or no prenatal care

[c] Gonorrhea, syphilis or bacterial vaginosis diagnosed during pregnancy

[d] Medicaid-paid delivery or prenatal care at public clinic

Table 3 Mothers' country of birth classified by UN regional sub-group

	Frequency	Percent
East African	149	2.34
Central African	32	0.50
North African	44	0.69
West African	39	0.61
Caribbean	101	1.59
North American	5396	84.92
Central American	19	0.30
South American	24	0.38
Central Asian	7	0.11
East Asian	58	0.91
South Asian	85	1.34
South East Asian	252	3.97
West Asian	77	1.21
Eastern European	14	0.22
North European	7	0.11
South European	32	0.50
Western European	18	0.28
Total	6354	100

lower or no different than rates in receiving countries in 45.5 and 18.2 % of the studies, respectively [8]. Unlike our study, the proportion of immigrants who were refugees in these studies was not estimated. The current study appears to be one of the few published studies to demonstrate significantly lower incidence of preterm birth among women from countries that send a large proportion of refugees to the US.

Previous studies have demonstrated that the incidence of preterm births among immigrants can vary by geographic region. For example, evidence suggests that immigrants from sub-Saharan Africa and Asia have higher likelihood of preterm births than native-born populations in developed countries [22, 23]. The majority of the foreign-born women in our sample originated from these regions, but we found significantly lower rates of preterm births overall and for these regional sub-groups. Our contrasting findings may be due to multiple factors such as differences in the countries of origin, the percentages of refugees, selective migration, the percentage of anticipatory refugees (i.e., refugees who sensed danger early and were able to plan an orderly departure from their homeland), and access to care in our sample, compared to previous studies. We discuss these factors as they relate to our findings below. Our overall conclusion is that additional primary research is needed to assess the contribution of these and other factors to the incidence of preterm births among foreign-born women in Syracuse, as well as other refugee resettlement communities.

Table 4 Bivariate and multivariate analysis of factors predicting preterm births among foreign-born and US-born women

Maternal characteristics	Bivariate model				Multivariate model			
	B	RR	95 % CI	p	B	ARR[e]	95 % CI	p
Foreign-born	−0.49	0.61	0.46–0.82	0.001	−0.40	0.67	0.49–0.89	0.007
Race/ethnicity								
Black/Hispanic	0.34	1.40	1.16–1.69	<0.001	0.35	1.42	1.18–1.72	<0.001
Other races	−0.03	0.97	0.76–1.24	0.79	0.08	1.08	0.85–1.39	0.52
White (referent)	–	1.00	–	–	–	1.00	–	–
Paternal involvement[a]	−0.31	0.73	0.61–0.88	0.001				
Late or no prenatal care[b]	0.77	2.15	1.64–2.81	<0.001	0.69	2.01	1.54–2.63	<0.001
Sexually transmitted infection[c]	0.26	1.29	1.08–1.55	0.006				
Drank alcohol	0.82	2.27	1.40–3.68	0.001				
Used drugs	0.69	2.00	1.61–2.49	<0.001				
Low socioeconomic status[d]	0.38	1.46	1.17–1.81	0.001				
Less than 18 years old	0.53	1.69	1.26–2.27	<0.001	0.40	1.50	1.11–2.02	0.008
Smoked 1st trimester	0.35	1.42	1.19–1.70	<0.001	0.31	1.37	1.14–1.64	0.001

[a] Birth record contains father's name and other paternal information

[b] First prenatal care in third trimester or no prenatal care

[c] Gonorrhea, syphilis or bacterial vaginosis diagnosed during pregnancy

[d] Medicaid-paid delivery or prenatal care at public clinic

[e] Adjusted relative risk: covariates include race, late/no prenatal care, maternal age ≤17 years. and smoking during 1st trimester

Table 5 Bivariate and multivariate analysis of factors predicting preterm births among women from refugee countries and US-born women

Maternal characteristics	Bivariate model				Multivariate model			
	B	RR	95 % CI	p	B	ARR[e]	95 % CI	p
Refugee	−0.59	0.56	0.38–0.81	0.002	−0.50	0.61	0.41–0.89	0.01
Race/ethnicity								
Black/Hispanic	0.34	1.40	1.16–1.69	<0.001	0.37	1.45	1.19–1.76	<0.001
Other races	−0.03	0.97	0.76–1.24	0.79	0.04	1.04	0.80–1.35	0.79
White (referent)	–	1.00	–	–	–	1.00	–	–
Paternal involvement[a]	−0.31	0.73	0.61–0.88	0.001				
Late or no prenatal care[b]	0.77	2.15	1.64–2.81	<0.001	0.76	2.13	1.63–2.79	<0.001
Sexually transmitted infection[c]	0.26	1.29	1.08–1.55	0.006				
Drank alcohol	0.82	2.27	1.40–3.68	0.001				
Used drugs	0.69	2.00	1.61–2.49	<0.001				
Low socioeconomic status[d]	0.38	1.46	1.17–1.81	0.001				
Less than 18 years old	0.53	1.69	1.26–2.27	<0.001	0.39	1.48	1.09–2.00	0.01
Smoked 1st trimester	0.35	1.42	1.19–1.70	<0.001	0.32	1.38	1.15–1.65	0.001

[a] Birth record contains father's name and other paternal information

[b] First prenatal care in third trimester or no prenatal care

[c] Gonorrhea, syphilis or bacterial vaginosis diagnosed during pregnancy

[d] Medicaid-paid delivery or prenatal care at public clinic

[e] Adjusted relative risk: covariates include race, late/no prenatal care, maternal age ≤17 years and smoking during 1st trimester

Previous studies have shown that perinatal outcomes, including preterm births, vary by country within regions. For example, perinatal outcomes such as preterm labor, primary cesarean delivery, pregnancy-associated hypertension, eclampsia, diabetes in pregnancy, low birth weight, macrosomia, and cephalopelvic disproportion are significantly different among Asian subgroups at a national level [24]. Our sample may be composed of foreign-born women who originate from countries in sub-Saharan Africa and Asia that have relatively lower rates of preterm birth,

compared to previous studies. However, the previous studies described participants according to their region (e.g., sub-Saharan African) rather than their country of origin (e.g., Burkina Faso) so we are unable to examine how the countries that our participants originated from differ from participants in previous studies.

Selective migration suggests that healthier individuals are more likely to immigrate to a new country than their less healthy counterparts [25]. This may partially explain why foreign-born women in the current sample experienced positive birth outcomes. Additionally, research suggests that the health differential for migrants is contingent upon the level of deprivation of the receiving country compared to the country from which individuals originated. According to Norman et al. [26], migrants are generally healthier than non-migrants when moving from more to less economically deprived locations, whereas migrants who relocate to more economically deprived areas tend to be less healthy (i.e., they have higher limiting long-term illness and mortality rates) than non-migrants. The majority of foreign-born women who resettled in Syracuse originated from countries that were relatively economically deprived as indicated by their gross national income per capita. According to data from the United Nations, the gross national income per capita in the US in 2012 was $52,013; whereas, the average gross national income per capita among birth mothers from the five most common foreign countries in the current sample (i.e., Burma, Somalia, North Vietnam, Cuba and Bhutan) was $1695 per year [27].

Although our research found that a significantly greater proportion of foreign-born women received their initial prenatal care during their third trimester or had no prenatal care than US-born mothers, a slightly higher percentage (99 %) of foreign-born women in our sample obtained prenatal care during their pregnancy than US-born women (98 %). This may be due to the fact that Syracuse is a designated refugee resettlement city with moderate resources and supports for immigrants and refugees, which may afford them better access to health care and to other resources than migrants typically experience. For example, refugees usually receive an initial health assessment within 30 days of their arrival in Syracuse [28]. Pregnant refugees are scheduled for prenatal care and typically have their initial visit within 2 weeks, and their appointments are usually scheduled at health centers where interpretive services are available.[1] Syracuse also has a network of public health programs, such as Syracuse Healthy Start, that seek to improve perinatal outcomes through referrals to physical and mental health services. Fifteen percent of the women

enrolled in the Healthy Start Program are foreign-born [29]. Among the foreign-born women who did utilize prenatal care in Syracuse, these services may play a role in their reduced rates of preterm birth.

Among the foreign-born women who received late or no prenatal care, it is unknown whether they arrived in Syracuse in later stages of pregnancy or used alternative, non-traditional resources to improve their birth outcomes. Research shows that refugees utilize a wide range of complementary and alternative medicine [30]. Reasons reported for utilizing alternative medicine included unfamiliarity with a new healthcare system, general illness, desire to continue traditional practices, and cultural bereavement (i.e., the experience of the uprooted person and loss of old sense of self, social structures, cultural values and meaning) [31]. Additionally, healthcare availability varied by immigration class from 2009 to 2011. Asylum seekers (i.e., refugees who have escaped from their home country but have not been granted asylum by their host country) and undocumented migrants (i.e., illegal immigrants, rejected asylum seekers, or individuals who overstayed their visas) in New York, were eligible for Emergency Medicaid and Emergency Medical Treatment. Also, women who were at or below 200 % of the federal poverty level were also eligible for two state-run programs that provided prenatal care [32]. Individuals who were granted asylum were eligible for the same benefits as refugees, such that they could apply for Medicaid or Refugee Medical Assistance for 8 months, if they were ineligible for Medicaid. Legal immigrants were eligible for Medicaid if they were pregnant and if their income was at or below 200 % of the federal poverty level, or they could be eligible for the Family Health Plus program which provides health insurance for individuals whose income exceeds Medicaid requirements. It is possible that women who did not receive any prenatal care were not eligible for state or federal healthcare and could not afford to pay for it. Lastly, research suggests that the language barrier between patients and health care providers prevents many immigrant, refugee, and asylum seeking women from accessing prenatal care [33, 34]. The language barrier both inhibits women from understanding information given to them by healthcare providers and limits women's ability to ask questions and discuss their symptoms with their providers [34]. Mexican immigrants reported that the language barrier decreases their willingness to seek out care, and that having translation services or a Spanish-speaking health aide in the clinic or in their neighborhood would increase their willingness to utilize reproductive health services [35].

Strengths

This study has several strengths that set it apart from many previous studies of preterm birth among foreign-born

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[1] Personal communication with Director of Catholic Charities Refugee Resettlement in Syracuse, NY, August 2014.

women. A strength of our study is that we attempt to distinguish between refugee and non-refugee immigrants and estimate their relative frequency in the sample. We found that 60 % of infants born to a foreign-born mother were born to women whose countries of origin include the twenty countries from which the local refugee population came (Table 1). We also conducted a separate analysis to compare the prevalence of preterm births among the sub-sample of women from the top 20 countries for refugees with the US-born sample. Our study represents a test of the healthy immigrant effect in samples of childbearing women with large estimated proportions of refugees. Although samples of immigrants in previous studies almost certainly contained refugees, no estimates of their relative frequencies in the samples are reported.

Furthermore, we detected a healthy immigrant effect among foreign-born women and women from refugee countries in a city that has a relatively low overall rate of preterm births, compared to national norms. The preterm birth rate among singleton infants for all Syracuse residents during 2009–2011 was 7.9 %, whereas the comparable rate for the US was 10.3 % [21]. Thus, the contrast between the preterm birth rate for singletons born to immigrant mothers (5.2 %) and to mothers from refugee countries (4.7 %) in Syracuse appears even stronger when compared to overall national norms.

Limitations

The current study also has a number of limitations. Refugee status of childbearing women in this sample is an estimation based on refugee resettlement data, rather than demographic information on the current sample. We assume that a high percentage of the foreign-born mothers in our sample are refugees because they originate from countries where the largest number of refugees to Syracuse, NY originated during the relevant time period. However, it is possible that the number of refugees in our sample may be either higher or lower than our estimates. In addition, secondary migration among refugees within the US and unknown length of US residency further obstruct our ability to provide accurate estimates of preterm births to refugees within Syracuse, NY. Primary data collection is needed to avoid misclassification and obtain more accurate estimates.

Although maternal nativity is an important factor when examining birth outcomes, primary data collection is needed in order to understand the mechanisms that drive the relationship between maternal nativity and preterm births. Therefore, another limitation is the secondary nature of this analysis, which constrained the variables that we were able to examine. First, differential levels of maternal stress between foreign-born and US-born mothers may contribute

to the disparity in preterm births. Fleuriet and Sunil [36] found that Mexican women report lower levels of prenatal stress than US-born Mexican–Americans. Additionally, a recent meta-analysis has found that higher levels of prenatal stress predict increased rates of preterm births [37], which is thought to be caused by increased inflammation [38]. Second, different levels of familial social support between foreign-born and US-born mothers may contribute to the disparity in preterm births. Research suggests that foreign-born Mexican–Americans receive greater social support from their family members than non-Latino Whites [39, 40] which increase women's likelihood of adopting behaviors that promote fetal health such as eating a better quality diet and taking prenatal vitamins during pregnancy [41]. Further, research suggests that maternal diet impacts birth outcomes through the nutrients that women receive and transfer to their fetus. Diets high in meat and fats and low in fruits and vegetables or that are lacking in saturated fatty acids put women at greater risk for preterm births [42–44].

Another limitation stems from the fact that we were unable to examine whether the protective effect of maternal nativity on preterm births declines as foreign-born mothers become more acculturated in the US. Guendelman et al. [45] found that the longer Mexican mothers resided in the US the greater risk they had for delivering preterm, lower birth weight infants, even after adjusting for maternal characteristics. Collins et al. [46] examined intergenerational birth weight patterns on US-born and foreign-born White and Black women. Their research showed that although the healthy immigrant effect was present, such that the descendants of foreign-born African or Caribbean mothers had a lower percentage of low birth weight infants than the descendants of US-born African American mothers, this advantage diminished with each generation. These authors suggest that birth outcomes may decline due to the fact that the descendants of foreign-born women were more likely to give birth as a teen and while they are unmarried. Although this work provides some mechanistic information, additional longitudinal studies that track lifestyle changes among immigrants in parallel with birth outcomes might elucidate primary factors responsible for the protective effect of foreign nativity. Primary data collection should be used in future research to assess these important variables.

Another limitation is that a robust stratified analysis of preterm births by maternal country of origin was not possible, due to the relatively small numbers of births to women from most countries. Our findings may not be representative of immigrants from under-represented countries in our dataset or the data from over-represented countries may be driving certain results. For example, a recent study (in progress) found that Iraqi refugees in

Syracuse are much better educated and have better English language skills than other refugees. It would be of interest to derive an estimate of preterm birth rates for Iraqis, but the sample size is insufficient to provide a precise estimate. Data from larger foreign-born populations or data for longer time periods are needed to examine the effect of mother's country of origin on perinatal outcomes.

Conclusion

Over 200,000 refugees resettled in the US between 2009 and 2011 [15]. Increased global instability will likely create more refugees seeking asylum in the US and other developed countries in the future. Furthermore, an increasing proportion of the countries from which the US receives refugees lack basic health and education infrastructure. Therefore, more refugees are coming to the US with little or no formal education and/or health care. As a result, more research is needed to understand the health outcomes of this growing and dynamic segment of the US population so that appropriate public health interventions can be developed. More population-based and individual case study analyses are needed to examine the healthy immigrant effect, especially in areas where refugees comprise a significant portion of the foreign-born population. By gaining a greater understanding of the mechanisms that contribute to the healthy immigrant effect, public health interventionists may be able to manipulate these same mechanisms to improve perinatal outcomes, such as preterm birth, among the US population.

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