



Impact of Immigration and Duration of Residence in US on Length of Gestation Among Black Women in Newark, New Jersey

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Abstract

Little is known about pregnancy outcomes of black immigrant women to the US. We surveyed 447 black women postpartum in two hospitals in Newark, NJ. Length of gestation was obtained from medical records. Covariates and information on immigration were collected by in-person interview. Risks ratios for preterm birth (<37 weeks) comparing immigrant to US-born women were calculated using log-binomial regression. Associations with gestational age at delivery were estimated using linear regression. Multivariable models adjusted for socioeconomic and social/behavioral variables. Immigrant women relative to US-born women had a 60% lower risk of preterm birth (adjusted risk ratio=0.4; 95% confidence interval (CI) 0.2, 0.8) and longer gestation (adjusted difference=1.4 weeks, 95%CI 0.6, 2.1). Gestation was 1.9 weeks longer for recent immigrants compared to US-born women (95%CI 0.2, 3.6), whereas for those who lived in the US for at least 10 years there was no difference. The healthy immigrant effect found among black immigrants may erode with time in the US.

Keywords Black immigrants · Preterm birth · Duration of residence · Length of gestation

Background

Preterm birth (PTB) represents a substantial public health problem in the United States and is a strong predictor of infant mortality and morbidity. PTB complicates over 450,000 deliveries every year with a rate of 9.6% of total births in 2013 being preterm [1]. Although there has been a steady decline in the overall PTB rate from the peak of 10.4% in 2007 to 9.5% in 2014 [1], rates of PTB rose 3% in 2016 from 9.5% in 2014 to 9.8% in 2016 [2]. The United States is one of the ten countries with the highest number of

estimated PTB worldwide [3]. Many studies have demonstrated the influence of maternal race on the risk for preterm birth; findings from these studies suggest that independent of maternal medical and socioeconomic factors, black American children are more likely to be born preterm compared to white children [4]. The heterogeneity in birth outcomes within racial groups is not well understood. In contrast to the plethora of research on black–white differences, adverse birth outcomes within populations of black women by nativity have received less attention.

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Immigrant studies of birth outcomes in the US have shown that black foreign-born mothers have generally better pregnancy outcomes compared to their US-born counterparts [5–16]. Several explanations have been proposed to explain this disparity in birth outcomes, which was first called the “Hispanic paradox,” referring to the findings that in spite of their low socioeconomic status, Mexican and Latin American immigrants tend to have perinatal health outcomes that are comparable to or better than their US-born counterparts. One explanation is known as the “healthy migrant effect” [17]. This theory posits that immigrants are positively selected in the process of immigration, such that they are in better physical and psychological health than women who did not immigrate. However, existing research suggests that health advantages for Hispanic immigrant women diminish with increased duration of residence in the United States [18]. When comparing pregnancy outcomes across generations, studies have found that the risk of preterm birth in Mexican immigrants increased with increased length of residence in the United States [19, 20]. Most of these studies have attributed this decline in pregnancy outcomes to the “acculturation hypothesis.” According to this hypothesis, as immigrants spend more time in the United States, their healthy behaviors, norms, and attitudes change, resembling those of non-immigrant groups with which they come into contact. Because pregnancy outcomes are affected by the shifts in health risks and changes in socio-demographic characteristics [21], the pregnancy outcomes of immigrants change as they spend more time in the United States. Immigrants’ body mass index (BMI) tends to increase as they live longer in the US [22]; repeated experiences with stressors are also linked to an “unhealthy assimilation” as immigrants lived longer in the US [23]. To our knowledge, no studies have directly examined the effect of the length of residence in the United States on pregnancy outcomes among black immigrant women.

Though small in number, African immigrants are among the fastest growing populations in the United States [24] with 3.9 million African immigrants living in the US in 2015. Black immigrants now account for 8.6% of the nation’s black population [25]. Newark, New Jersey, with a large and diverse black immigrant population, is an ideal setting in which to study this question. Our objectives were: (1) to examine the risks of preterm birth and length of gestation in black immigrant women relative to US-born black women and (2) to determine the association between the duration of residence in the United States and the length of gestation in black immigrant women.

Methods

Data Collection

This study utilized secondary data from a survey of the pregnancy experiences of African American women. Participants were black women who gave birth at two maternity hospitals in Newark, New Jersey during 2013–2014. The hospitals in the study are the only two maternity hospitals in Newark and represent the source population of all women delivering in Newark. A total of 340 US-born and 107 foreign-born black women participated in the survey. Women who gave birth in the past week were approached in the post-partum unit and invited to participate in the survey. Women who self-identified as black or African American and could answer the questionnaire in English were eligible. We invited all eligible admitted patients in the unit to participate on at least 2 weekdays, which were selected based on availability of the interviewers. Interviews were conducted after obtaining written consent. Participants were offered a ten-dollar gift card for their time. The questionnaire included information on foreign-born status and age at immigration to the US, demographic information (e.g. age, education, marital status, and insurance). The survey also included questions about their pregnancy history, preterm birth knowledge, cigarette smoking and alcohol consumption, and beliefs about body health. The study was approved by the Rutgers University Biomedical and Health Science (RBHS) Institutional Review Board.

Measurement of Variables

The main outcomes examined in this study were preterm birth and length of gestation. Gestational age at delivery, estimated in completed weeks, was obtained from participants’ medical records as the clinician’s best estimate. Preterm birth is defined by the World Health Organization as a delivery at less than 37 weeks of gestation.

The main study exposures were foreign-born status and duration of residence in the United States. Immigrants were defined as those who answered “no” to the question “were you born in the United States?” Those who answered “yes” to the same question were categorized as non-immigrants and were treated as a reference category. Immigrants’ “duration of residence” was defined as time (in years) from the time they first came to the United States to the time of the interview. The immigrants were further categorized into two groups: recent immigrants, defined as having spent less than 5 years in the US, and long-term immigrants, defined as those who had resided for

5 or more years in the US. The 5-year cut-off point for duration of residence was chosen based on study findings indicating that immigration effect on birth outcomes may be detectable as early as 5 years after entry into the United States [20].

Covariates

We chose demographic/socioeconomic and social/behavioral characteristics as covariates for analysis that may be associated both with immigrant status and preterm birth. Demographic/socioeconomic covariates included maternal age, maternal education (high school diploma or higher degree, no high school diploma), insurance status (Medicaid, private, none/other), and marital status (married or living with the father of the baby, single going with the father but not living together, single not with the father/widowed). Maternal health behavior included tobacco smoking and alcohol drinking, which are linked to adverse pregnancy outcomes [26, 27]. Smoking history was reported as the number of cigarettes, black cigars, mild cigars, or other tobacco products, smoked a day, which were categorized into smoked 3 months before pregnancy (yes/no). Alcohol use history was reported as the number of glasses of wine, wine coolers, cans or bottles of beer, or alcoholic drinks consumed a week and categorized into drank 3 months before pregnancy (yes/no). Pregnancy intention was assessed by the question “When you got pregnant with your new baby, were you trying to get pregnant?”.

Analysis

We used univariate analysis to examine the frequency distribution of various variables stratified by maternal migrant status. Adjusted and unadjusted risk ratios estimating the associations between immigrant status and preterm birth were calculated using log-binomial regression with “US-born” as the referent category [28]. We calculated mean differences in gestational age at delivery in weeks for non-immigrants and immigrants using linear regression. Differences were also calculated by years of residence in US for immigrants (<2, 2–4, 5–9, and 10 or more). Test for linear trend was tested by adding a categorical variable of years in the US as a covariate and using the Wald χ^2 test to test the null hypothesis that the coefficient for linear trend = 0. Covariates were added sequentially to models for preterm birth and mean gestational age at delivery as follows: (1) maternal age; (2) maternal education, insurance status, marital status; (3) smoked 3 months prior to pregnancy, drank 3 months prior to pregnancy, trying to get pregnant, trimester entered prenatal care. Statistical analysis was performed using SAS 9.4 software.

Results

Table 1 shows the general characteristics of the study population. Immigrants represent 23.9% of the total study sample. Immigrants on average were older than non-immigrants (mean age; 29.9; 95%CI 28.7–31.1 and 26.3; 95%CI 25.7–26.9), respectively. Almost sixty percent (58.9%) of immigrants were married or living with the father of the baby compared to 35.8% of non-immigrants. 37.4% of immigrants had a high school diploma compared to 44.3% of non-immigrants. The percentage of women with college education was higher in immigrants compared to non-immigrants (56.1% and 41.0%), respectively. Fewer immigrants reported cigarette smoking and alcohol consumption than US-born women: 4.7% of immigrants reported smoking cigarettes 3 months prior to pregnancy, while 34.9% of US-born reported the same. US-born women were twice as likely to report consuming alcohol 3 months prior to pregnancy (49.9%) compared to non-immigrants (20.8%). Immigrants were more likely to initiate early prenatal care: 75.5% of immigrants started prenatal care during the first trimester of pregnancy compared to 62.3% of non-immigrants. Immigrants were almost three times more likely to be uninsured than non-immigrants: 13.3% of immigrants had no health insurance compared to 4.5% of non-immigrants. Immigrants were less likely to report unintended pregnancy: 58.9% of immigrants reported unplanned pregnancy compared to 83.9% of non-immigrants reporting the same. Approximately half of the immigrant women in the study were from Africa and half from the Caribbean. The most common countries of birth were Haiti (n = 23), Nigeria (n = 16), Jamaica (n = 15), Ghana (n = 11), and Liberia (n = 7) (data not shown).

Immigrant women had a lower risk ratio of preterm birth than US-born women in unadjusted analyses (Risk ratio (RR)=0.6; 95%CI 0.3–1.2), after adjusting for socioeconomic variables (RR = 0.5; 95%CI 0.3–1.1), and after adjustment for social and behavioral variables (RR = 0.4; 95%CI 0.2–0.8) (Table 2). Confidence intervals were wide and included the null for the first two models.

Mean Gestational Age

The mean gestational age at delivery was 38.2 weeks (SD 3.0) for the US-born and 38.9 weeks (SD 2.3) for the immigrant women. In both of the adjusted models, the mean gestational age at delivery for immigrants was 1.0 weeks higher than the mean gestational age at delivery for the US-born (95%CI 0.4–1.7) (Table 3). The duration of gestation for immigrants decreased with increasing time in the US (Table 4). Differences for immigrant women

Table 1 Characteristics of study population of black women by immigrant status, Newark, 2013–2014 (n = 447)

	Immigrants n(%)	US-born n(%)	
Total	107 (23.9)	340 (76.1)	
Age at interview			<0.001
≤20	9 (8.4)	32 (9.4)	
20–24	18 (16.8)	132 (38.9)	
25–29	57 (53.3)	143 (42.2)	
≥30	23 (21.5)	32 (9.4)	
Maternal education			0.009
No high school diploma	7 (6.5)	50 (14.8)	
High school diploma or equivalent	40 (37.4)	150 (44.3)	
Some college or higher	60 (56.1)	139 (41.0)	
Insurance status			0.004
Medicaid	73 (69.5)	271 (80.7)	
Private/other	18 (17.1)	50 (14.9)	
None	14 (13.3)	15 (4.5)	
Marital status			<0.001
Married or living with baby's father	63 (58.9)	121 (35.8)	
Single and with baby's father	27 (25.2)	144 (42.6)	
Single and not with baby's father or widowed	17 (15.9)	72 (21.6)	
Smoked cigarettes 3 months before pregnancy			<0.001
Yes	5 (4.7)	117 (34.9)	
No	101 (95.3)	218 (65.1)	
Drank alcohol 3 months before pregnancy			<0.001
Yes	22 (20.8)	167 (49.9)	
No	84 (79.3)	168 (50.2)	
Trying to get pregnant			<0.001
Yes	44 (41.1)	54 (16.1)	
No	63 (58.9)	281 (83.9)	
Trimester started prenatal care			0.03
1st	80 (75.5)	208 (62.3)	
2nd	23 (21.7)	101 (30.2)	
3rd or none	3 (2.8)	25 (7.5)	

Table 2 Unadjusted and adjusted risk ratios for preterm birth by immigrant status among black women, Newark 2013

	Preterm birth (<37 weeks)				
	n (%)	Unadjusted risk ratio (95%CI)	Adjusted risk ratio (95%CI) ^a	Adjusted risk ratio (95%CI) ^b	Adjusted risk ratio (95%CI) ^c
Immigrants	9 (8.4%)	0.6 (0.3, 1.2)	0.6 (0.3, 1.1)	0.5 (0.3, 1.1)	0.4 (0.2, 0.8)
US-born	46 (13.5%)	Referent	Referent	Referent	Referent

^aAdjusted for age^bAdditionally adjusted for socioeconomic variables (education, insurance, marital status)^cAdditionally adjusted for social and behavioral variables (smoked, drank, trying to get pregnant, prenatal care)

compared to US-born women, adjusting for age, were largest for those who arrived in the US within the last 2 years (risk difference (RD) = 1.6, 95%CI 0, 3.2), followed by those who arrived in the US within the 2–4 years (RD = 1.4, 95%CI 0.1, 2.8) and 5–9 years (RD = 1.4,

95%CI 0.2, 2.5). Immigrant women who had been in the US at least 10 years had a similar difference in gestational length as those born in the US (RD = -0.6, 95%CI = -0.4, 1.5). Results were similar after adjusting for socioeconomic variables and social/behavioral variables. Test for

Table 3 Unadjusted and adjusted mean difference in gestational age at delivery by immigrant status and duration of residence among African American women, Newark, 2013

	Unadjusted mean gestational age (SD)	Unadjusted difference in weeks (95%CI)	Adjusted difference in weeks (95%CI) ^a	Adjusted difference in weeks (95%CI) ^b	Adjusted difference in weeks (95%CI) ^c
Immigrants	38.9 (2.3)	0.8 (0.3, 2.4)	1.0 (0.4, 1.7)	1.0 (0.4, 1.7)	1.4 (0.6, 2.1)
US-born	38.2 (3.0)	Referent	Referent	Referent	Referent

^aAdjusted for age^bAdditionally adjusted for socioeconomic variables (education, insurance, marital status) (n=427)^cAdditionally adjusted for social and behavioral variables (smoked, drank, trying to get pregnant, prenatal care) (n=415)**Table 4** Unadjusted and adjusted mean difference in gestational age at delivery by immigrant status and duration of residence among African American women, Newark, 2013

	n	Unadjusted mean gestational age (SD)	Unadjusted difference in weeks (95%CI)	Adjusted difference in weeks (95%CI) ^a	Adjusted difference in weeks (95%CI) ^b	Adjusted difference in weeks (95%CI) ^c
Immigrants						
<2 years in US	13	39.6 (1.3)	1.4 (−0.2, 3.0)	1.6 (0, 3.2)	1.6 (0, 3.1)	1.9 (0.2, 3.6)
2–4 years in US	19	39.4 (1.3)	1.2 (−0.1, 2.5)	1.4 (0.1, 2.8)	1.5 (0.1, 2.8)	1.8 (0.5, 3.2)
5–9 years in US	27	39.3 (1.3)	1.1 (0, 2.3)	1.4 (0.2, 2.5)	1.3 (0.2, 2.4)	1.8 (0.6, 2.9)
10 or more years in US	41	38.3 (3.2)	0.1 (−0.8, 1.0)	0.6 (−0.4, 1.5)	0.5 (−0.5, 1.5)	0.9 (−0.2, 1.9)
US-born	347	38.2 (3.0)	Referent	Referent	Referent	Referent
Test for trend Wald χ^2 p-value			0.13	0.01	0.02	0.004

^aAdjusted for age^bAdditionally adjusted for socioeconomic variables (education, insurance, marital status) (n=427)^cAdditionally adjusted for social and behavioral variables (smoked, drank, trying to get pregnant, prenatal care) (n=415)

linear trend with category of time in the US was significant for all adjusted models ($p < 0.05$).

Discussion

Our findings suggest that immigrant black women have a reduced risk of preterm birth and increased length of gestation compared to US-born black women. Duration of residence of immigrants in the US was also found to be associated with length of gestation. Recent immigrants (<2 years) had the longest length of gestation, followed by those living in the US between 2 and 4 or 5–9 years. After living in the US at least 10 years the relative advantage compared to US-born women was no longer present.

Despite the public health efforts aimed at eliminating disparities in preterm birth [29] the prematurity-related white–black gap remains significantly high. Causes of these persisting disparities remain largely unknown; studies have focused on differential exposures during pregnancy to risk factors known to be associated with preterm birth such as maternal smoking. In Newark, 4.7% of immigrant black women in the study sample reported smoking 3 months prior to pregnancy whereas 34.9% of US-born women reported

the same. However, differences in preterm birth risk ratios remained significant even after adjustment for smoking. This finding is consistent with studies showing that black women have higher rates of preterm birth than white women despite lower rates of smoking, suggesting smoking does not explain differences in preterm birth risk [30]. Besides smoking, immigrant black women in our study were more likely to have higher education, be married, and have intended pregnancies than US-born black women. Studies that examined the “healthy migrant effects” in birth outcomes have shown a protective effect of immigrant status among women with lower levels of education [31], despite low education being a strong risk factor for preterm birth [32]. However, that pattern did not hold for black immigrant women in Newark, who are more highly educated than native women. Our findings of the relatively healthy risk profile and outcomes of immigrant black women in Newark add to the notion that immigrants are a widely diverse group and should be studied in local context.

Our finding that the increased duration of gestation in immigrants compared to US-born women is consistent with the existing literature that immigrants have more favorable birth outcomes relative to their US-born counterparts [14, 20, 21]. Increasing duration of residence in the US was

associated with decreasing length of gestation, suggesting that the health advantage of the effect of recent immigration on gestational age at delivery is lost over time. Our finding adds to increasing evidence that the health advantages of an immigrant decline even within immigrants' first generation, and merits further examination in a larger sample [20, 33].

Some researchers have used the life course perspective to better understand the contribution of the exposure to unhealthy behavior on the racial disparities in pregnancy outcomes. According to the life course perspective, past exposure to health risk behaviors may have the same impact on the reproductive outcomes as the current exposure [34]. Lifelong exposure to both psychosocial stressors and environmental chemicals have been found to be associated with adverse pregnancy outcomes; tobacco smoke and psychological stresses could produce multiplicative effects on the vascular system and placental blood vessels, which could compromise the fetal blood flow, in turn increasing the risks for intra-uterine growth retardation, PTB, and fetal death [35, 36]. Thus the lifecourse perspective suggests that although immigrant and US-born black women in Newark may share geography and environment, differential life course exposures may translate into differential risk of preterm birth.

Our study utilized cross sectional data from a survey of pregnancy experiences of African women in Newark, New Jersey which have several limitations. There was a potential for responder bias as maternal smoking and alcohol consumption were self-reported by women during the interviews. Women tend to not disclose their smoking and drinking habits during pregnancy because of perceived social stigma [37]. Any differential in reporting bias by immigrant status could influence measures of association. Our study sample was not strictly a random sample, as interviewers recruited subjects on only some days of the week. The possibility exists that patients on a given weekday are different than others, which could bias the results in an unknown direction. An additional important limitation which weakens our study was the relatively small sample size to study preterm birth. There were only 8 preterm birth events in the immigrant group, so measures of association were not precise and all findings regarding preterm birth should be interpreted with caution and considered exploratory only. We did not have sufficient sample size to explore immigration and preterm birth by country of origin. Nonetheless, the overall pattern of lower risk among black immigrant women was robust to several analytic approaches. Further, we did not have information on reason for migration, which would have enabled us to test if the differences in gestation by years in the US were due to a cohort effect.

To aid in assessing the external validity of our study, we compared our study sample characteristics to births to black women residing in Newark using the New Jersey State Health Assessment Data (NJSHAD) online

query system, and profiles were similar. For example, in 2013, 19.3% of births were to foreign-born women versus 23.9% in our study. 56.3% of black immigrant women were insured by Medicaid, compared to 69.5% in our study, and 67.8% of black US-born women were insured by Medicaid, compared to 80.7% in our study. Nonetheless, the possibility of selection bias exists if black immigrant women who chose to participate in the survey were different in the demographic/socioeconomic and social/behavioral characteristics than the women who chose not to participate in the survey. Moreover, our study limited participants to English speaking women, so our sample may not be generalizable to other more diverse sample of black women.

Despite these limitations, our study also has several strengths. Newark is a unique setting to study immigration and pregnancy outcomes among black women, as the majority of the population is black with a relatively large proportion of foreign-born women. Because we surveyed women at time of delivery, we avoided the selection bias occurring in studies that recruit women during prenatal care, in which vulnerable women who do not access care are not included. Also, our data was collected by patient survey and medical record abstraction, which is unique compared to most studies of immigrant outcomes which use administrative data, which usually has weaker internal validity. Finally, measures of years in the US and country of origin are not readily available in birth certificate data, on which many studies of immigrant reproductive health in the US are based, making our study unique.

Conclusion

Black immigrant women had a lower risk of preterm birth and longer duration of gestation than those born in the US. The advantage of the effect of recent immigration on gestational age at delivery declined as the duration of residence in the US increased. The fact that changes in the duration of gestation and preterm births in black immigrant women take place within a relatively short period after migration suggest that environmental factors may play a considerable role behind the deterioration of their pregnancy outcomes. Therefore, efforts to reduce the negative outcomes associated with PTB in black immigrants may need to focus on preventing the modifiable environmental factors. The clarification of the mechanisms behind the association between duration of residence and length of gestation, including contextual influences such as neighborhood of residence, merit further investigation in a larger study.

References

- Hamilton BE, Martin JA, Osterman MJK, et al. Births: final data for 2014. *Natl Vital Stat Rep*. 2015;64(12):1–64.
- Hamilton BE, Martin JA, Osterman MJK, et al. Births: provisional data for 2016. *Vital statistics rapid release*. vol 2. Hyattsville, MD: National Center for Health Statistics. <https://www.cdc.gov/nchs/data/vsrr/report002.pdf>. Accessed 21 Sept 2017.
- Blencowe H, Cousens S, Chou D, Oestergaard M, Say L, Moller AB, et al. Born too soon: the global epidemiology of 15 million preterm births. *Reprod Health*. 2013;10(Suppl 1):2. <https://doi.org/10.1186/1742-4755-10-S1-S2>.
- Kistka ZAF, Palomar L, Lee KA, Boslaugh SE, Wangler MF, Cole FS, et al. Racial disparity in the frequency of recurrence of preterm birth. *Am J Obstet Gynecol*. 2007;196(2):131–e1.
- Howard DL, Marshall SS, Kaufman JS, Savitz DA. Variations in low birth weight and preterm delivery among Blacks in relation to ancestry and nativity: New York City, 1998–2002. *Pediatrics* 2006;118:e1399–405.
- Cabral H, Fried LE, Levenson S, Amaro H, Zuckerman B. Foreign-born and US-born Black Women: differences in health behaviors and birth outcomes. *Am J Public Health*. 1990;80:70–2.
- Chavkin W, Busner C, McLaughlin M. Reproductive health: Caribbean women in New York City, 1980–1984. *Int Migr Rev*. 1987;21(3):609–625.
- Fang J, Madhavan S, Alderman MH. Low birth weight: race and maternal nativity—impact of community income. *Pediatrics* 1999;103(1):e5.
- Friedman DJ, Cohen BB, Mahan CM, Lederman RI, Vezina RJ, Dunn VH. Maternal ethnicity and birthweight among blacks. *Ethn Dis*. 1993;3(3):255–69.
- Kleinman JC, Fingerhut LA, Prager K. Differences in infant mortality by race, nativity status, and other maternal characteristics. *Am J Dis Child*. 1991;145(2):194–9.
- Pallotto EK, Collins JW Jr, David RJ. Enigma of maternal race and infant birth weight: a population-based study of US-born Black and Caribbean-born Black women. *Am J Epidemiol*. 2000;151(11):1080–5.
- Rosenberg KD, Desai RA, Kan J. Why do foreign-born blacks have lower infant mortality than native-born blacks? New directions in African-American infant mortality research. *J Natl Med Assoc*. 2002;94(9):770.
- Singh GK, Yu SM. Adverse pregnancy outcomes: differences between US- and foreign-born women in major US racial and ethnic groups. *Am J Public Health*. 1996;86(6):837–43.
- Acevedo-Garcia D, Soobader MJ, Berkman LF. The differential effect of foreign-born status on low birth weight by race/ethnicity and education. *Pediatrics* 2005;115(1):e20.
- Urquia ML, Glazier RH, Blondel B, Zeitlin J, Gissler M, Macfarlane A, et al. International migration and adverse birth outcomes: role of ethnicity, region of origin and destination. *J Epidemiol Commun Health*. 2010;64(3):243.
- David RJ, Collins JW Jr. Differing birth weight among infants of US-born blacks, African-born blacks, and US-born whites. *New Engl J Med*. 1997;337(17):1209–14.
- Fennelly K. The “healthy migrant” effect. *Minn Med*. 2007;90(3):51–3.
- Ceballos M. Simulating the effects of acculturation and return migration on the maternal and infant health of Mexican immigrants in the United States: a research note. *Demography* 2011;48(2):425–36.
- Bukowski R, Robinson J. 17: Residence in the US a risk factor for preterm birth. *Am J Obstet Gynecol*. 2012;206(1):S12.
- Guendelman S, English PB. Effect of United States residence on birth outcomes among Mexican immigrants: an exploratory study. *Am J Epidemiol*. 1995;142(Supplement_9):30–8.
- Jamner M, Schneider, Stokols D, editors *Promoting human wellness: new frontiers for research, practice, and policy*. Berkeley: University of California Press. 2000. <http://ark.cdlib.org/ark:/13030/kt4r29q2tg/>.
- Guendelman SD, Ritterman-Weintraub ML, Fernald LCH, Kaufner-Horwitz M. Weight status of Mexican immigrant women: a comparison with women in Mexico and with US-born Mexican American women. *Am J Public Health*. 2013;103(9):1634–40. <https://doi.org/10.2105/AJPH.2012.301171>.
- Kaestner R, Pearson JA, Keene D, Geronimus AT. Stress, allostatic load, and health of Mexican immigrants. *Soc Sci Q*. 2009;90(5):1089–111.
- Anderson M. (2015). African immigrant population in U.S. steadily climbs. Pew research center. <http://www.pewresearch.org/fact-tank/2017/02/14/african-immigrant-population-in-u-s-steadily-climbs/>. Accessed 9 Mar 2018.
- United States Census Bureau. Selected characteristics of the native and foreign-born populations: 2011–2015 American community survey 5-year estimates. U.S. Census Bureau, 2011–2015 American community survey 5-year estimates. 2015. https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_15_5YR_S0501&prodType=table. Accessed 18 Oct 2017.
- Amasha H, Jaradeh M. Effect of active and passive smoking during pregnancy on its outcomes. *Health Sci J*. 2012;6:335–52.
- Albertsen K, Andersen AMN, Olsen J, Grønbaek M. Alcohol consumption during pregnancy and the risk of preterm delivery. *Am J Epidemiol*. 2004;159(2):155–61.
- Tian L, Liu K, Spiegelman D, Hertzmark E. Re: Easy SAS calculations for risk or prevalence ratios and differences. *Am J Epidemiol*. 2005;162:1157–8; author reply 1159–61.
- Institute of Medicine (US) Committee on Understanding Premature Birth and Assuring Healthy Outcomes, Behrman RE, Butler AS, editors. *Preterm birth: causes, consequences, and prevention*. Washington, DC: National Academies Press, US; 2007. <http://www.ncbi.nlm.nih.gov/books/NBK11365/>. Accessed 14 Sept 2017.
- Floyd RL, Rimer BK, Giovino G, Mullen PD, Sullivan SE. A review of smoking in pregnancy: effects on pregnancy outcomes and cessation efforts. *Annu Rev Public Health*. 1993;14:379–411.
- Janevic T, Savitz DA, Janevic M. Maternal education and adverse birth outcomes among immigrant women to the United States from Eastern Europe: a test of the healthy migrant hypothesis. *Soc Sci Med*. 2011;73(3):429–35.
- Luo Z-C, Wilkins R, Kramer MS, for the Fetal and Infant Health Study Group of the Canadian Perinatal Surveillance System. Effect of neighbourhood income and maternal education on birth outcomes: a population-based study. *CMAJ* 2006;174(10):1415–20. <https://doi.org/10.1503/cmaj.051096>.
- Crump C, Lipsky S, Mueller BA. Adverse birth outcomes among Mexican-Americans: are US-born women at greater risk than Mexico-born women? *Ethn Health*. 1999;4(1–2):29–34.
- Halfon N, Larson K, Lu M, Tullis E, Russ S. Lifecourse health development: past, present and future. *Matern Child Health J*. 2014;18(2):344–65. <https://doi.org/10.1007/s10995-013-1346-2>.
- Salafia C, Shiverick K. Cigarette smoking and pregnancy. II. Vascular effects. *Placenta* 1999;20:273–9.
- Berg C, Wilcox L, d’Almada P. The prevalence of socioeconomic and behavioral characteristics and their impact on very low birth weight in black and white infants in Georgia. *Matern Child Health J*. 2001;5(2):75–84.
- Venditti CC, Smith GN. Self-reported cigarette smoking status imprecisely quantifies exposure in pregnancy. *Open J Obstet Gynecol*. 2012;2(01):56.