Ethnic enclaves and gestational diabetes among immigrant women in New York City

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Abstract:

Previous research has shown that immigrants living in their own ethnic enclave are at decreased risk of poor health outcomes, but this question has not been studied in relation to gestational diabetes, an important early marker of lifecourse cardiovascular health. We ascertained gestational diabetes, census tract of residence, and individual-level covariates for Sub-Saharan African, Chinese, South Central Asian, Non-Hispanic Caribbean, Dominican, Puerto Rican, Mexican, and Central and South American migrant women using linked birth-hospital discharge data for 89,703 singleton live births in New York City for the years 2001–2002. Using 2000 census data, for each immigrant group we defined a given census tract as part of an ethnic enclave based on the population distribution for the corresponding ethnic group. We estimated odds ratios for associations between living in an ethnic enclave and risk of gestational diabetes adjusted for neighborhood deprivation, percent commercial space, education, age, parity, and insurance status, using multilevel logistic regression. Overall, we found no effect of ethnic enclave residence on gestational diabetes in most immigrant groups. Among South Central Asian and Mexican women, living in a residential ethnic enclave was associated with an increased odds of gestational diabetes. Several explanations are proposed for these findings. Mechanisms explaining an increased risk of gestational diabetes in South Central Asian and Mexican ethnic enclaves should be examined.

Keywords: Immigrant | Neighborhood | Gestational diabetes | Pregnancy

Article:

1. Introduction

A growing body of literature suggests that living in a neighborhood of shared ethnic ancestry, or 'ethnic enclave', has a positive influence on immigrant health (Pickett and Wilkinson, 2008). Research regarding the influence of ethnic enclaves on pregnancy health has been limited, however, by the use of broad ethnic categories and a lack of focus on immigrant women.

Gestational diabetes is a substantial public health problem among immigrant women, and therefore is a particularly relevant health outcome to study in relation to ethnic enclaves. An investigation of how ethnic enclaves influence the risk of gestational diabetes among specific immigrant groups will inform our understanding of how neighborhoods influence immigrant health.

2. Background

Gestational diabetes is a significant public health problem affecting approximately 7% of pregnancies, with implications for the mother's and infant's health across the lifecourse (Trial, 2004). Gestational diabetes mellitus, defined as diabetes with onset during pregnancy, is a common but serious pregnancy complication that can result in increased morbidity to both the infant and mother, including perinatal mortality, preterm birth, cesarean section, macrosomia, and trauma during delivery (Wendland et al., 2012). Women diagnosed with gestational diabetes during pregnancy are at an increased risk of chronic diabetes and hypertension postpartum, and it is now recognized that pregnancy acts as a "stress test", providing early evidence of cardiovascular disease risk (Bellamy et al., 2009). Gestational diabetes is a growing immigrant health issue. Recent research has shown that many groups of immigrant women are at a higher risk of gestational diabetes than U.S.-born women, and the incidence of gestational diabetes varies substantially by ethnicity (Kieffer et al., 1999, Savitz et al., 2008; Urquia et al., 2011, Vangen et al., 2003). Diet, obesity, physical activity, and maternal age at delivery are also important risk factors for gestational diabetes (Tobias et al., 2011, Torloni et al., 2009, Zhang and Ning, 2011) and have been shown to differ by immigrant status. Because these factors show a high degree of social patterning, it is plausible that features of the social environment such as living within ethnic enclaves influence the risk of gestational diabetes.

The influence of living within ethnic enclaves on pregnancy health has received increased attention by health researchers. Some limitations of previous studies include the use of absolute ethnic concentration to define an ethnic neighborhood, broadly defined ethnic groups, and limited pregnancy outcomes. Ethnic enclave is defined as an area where "immigrant groups [which] concentrate in a distinct spatial location and organize a variety of enterprises serving their own ethnic market and/or the general population" (Portes and Jensen, 1992). Although first conceptualized in the sociology literature to investigate the economic mobility of immigrants, the concept of ethnic neighborhoods has been commonly operationalized in health literature as ethnic concentration or ethnic density, often defined as the percent of persons of the same ethnic background in a defined geographic space (Pickett and Wilkinson, 2008, Xie and Gough, 2011). A weakness with defining ethnic enclaves by categorizing ethnic concentration at the same value across varying ethnic groups is that the relevant value to define an ethnic enclave may differ among groups, depending on the population size of the group. For example, because the population of Senegalese immigrants is much smaller than the population of Dominican immigrants in New York City, the percent of persons that are Senegalese in a given neighborhood that represents an ethnic enclave may be a smaller than for Dominican immigrants. In this scenario, a neighborhood in which a small percentage of the residents are Senegalese might be the neighborhood in which immigrants from Senegal have social networks and businesses serving their own ethnic market (e.g. Le Petit Senegal in Harlem). In contrast, a neighborhood in which a much greater percentage of the residents are Dominican may define an ethnic enclave for Dominican immigrants (e.g. Washington Heights). Therefore, the relative ethnic concentration of a particular immigrant as opposed to the absolute concentration may better define an ethnic enclave (Logan et al., 2002).

Another weakness of previous research on ethnic concentration/density and pregnancy outcomes is that it has focused on broadly defined Black and Hispanic groups in the U.S., inappropriately combining groups with distinct ethnic enclaves, and not examining foreign-born women as a unique population. Finally, current literature on ethnic concentration/density has focused primarily on birth weight and preterm birth. These studies generally found either no effect or a protective effect of increasing ethnic concentration/density (Jenny et al., 2001, Mason et al., 2010, McLafferty et al., 2012, Osypuk et al., 2010, Pickett et al., 2009, Shaw et al., 2010), or did not specifically examine immigrant populations (Mason et al., 2011). No previous study, to our knowledge, has examined associations between ethnic concentration/density and gestational diabetes.

Cultural assimilation may be an important influence on immigrant perinatal health. Women who live outside of their residential ethnic enclave may be more assimilated, and therefore, more acculturated to a sedentary lifestyle and American diet. Broadly defined, assimilation is the process by which immigrants are incorporated into the cultural life of the receiving country, and acculturation is the process by which an immigrant group adopts the behaviors or beliefs of another group (Lopez-Class et al., 2011, Teske and Nelson, 1974). Spatial assimilation theory states that as ethnic minorities acculturate they leave their ethnic enclaves for more ethnically mixed neighborhoods (Massey, 1985). Less cultural assimilation predicts residence in immigrant neighborhoods (Clark and Blue, 2004, Ellis et al., 2006, Logan et al., 2002). Further, the "healthy migrant theory" posits that due to selection processes which enable healthier persons to migrate, migrants arrive in the U.S. with a health advantage (Palloni and Ewbank, 2004) that may erode over time. Time in the U.S., a proxy measure for acculturation, has been associated with increased BMI in Latina women (Akresh, 2007, Antecol and Bedard, 2006, Gordon-Larsen et al., 2003, Kaplan et al., 2004, Sundquist and Winkleby, 2000) and Asian women (Lauderdale and Rathouz, 2000, Yeh et al., 2009). A study in New York City found that Latinas living in neighborhoods with a greater percentage of Spanish-speaking households had higher diet quality (Park et al., 2011). Overall, literature on acculturation and diet in Latinos suggests an association between acculturation to the U.S. diet and poor diet quality, with the caveat that such associations are often cross-sectional in nature and fail to incorporate a transnational perspective (Martínez, 2013, Pérez-Escamilla and Putnik, 2007). Because higher BMI and poor diet, two important risk factors for gestational diabetes, are associated with increased time in the U.S., and living outside of a residential ethnic enclave is associated with increased time in the U.S., it is plausible that living in a residential ethnic enclave is associated with a reduced risk of gestational diabetes.

A second mechanism by which living in a residential ethnic enclave might be protective of perinatal health is the presence of immigrant social networks, resulting in increased social and instrumental support (Buka et al., 2003). Social networks of immigrant women are important in their accessing community services (Neufeld et al., 2002). Furthermore, a study in the United Kingdom (UK) found increased levels of social support and decreased rates of mental illness in ethnic enclaves (Halpern and Nazroo, 2000). It is unknown if greater levels of social support lead to a decreased risk of gestational diabetes, although increased social support has been associated with increased compliance with dietary recommendations in women diagnosed with gestational diabetes (Ruggiero et al., 1990).

Given previous literature suggesting that increased ethnic concentration is generally protective of health during pregnancy, and the plausibility of spatial assimilation and social and instrumental support as mechanisms, we hypothesized that residence in an ethnic enclave of shared ethnicity would be associated with a decreased risk of gestational diabetes. We tested this hypothesis among Sub-Saharan African, Chinese, South Central Asian, Non-Hispanic Caribbean, Dominican, Puerto Rican, Mexican, and Central and South American immigrant women. We chose to explore each immigrant group separately in order to capture differences in the ethnic concentration of each group and to consider the unique socio-historical context of groups when interpreting results.

3. Methods

3.1. Data sources and study sample

We used a dataset consisting of New York City birth certificate data linked to hospitalization data for the years 2001–2002 for 242,097 births. The birth data were geocoded to the mother's 2000 census tract by the New York City Department of Mental Health and Hygiene. Of 242,097 eligible singleton live births, we excluded 4675 (1.9%) with missing data on the census tract of mother's residence, and 17,920 (7.5%) whose mother's residence was outside of New York City, leaving a total of 210,926 births. Of these, 89,703 were births to immigrant mothers from the regions of interest and comprised the analytic sample for univariate analyses. A total of 699 women with missing data on covariates were excluded from multivariable models, leaving n = 89,004 observations with complete data on all covariates. The number of births per tract ranged from 1 to 464 (mean = 42 births, median = 27 births). The mean number of births per tract for each specific immigrant group ranged from 3 births per tract to women from Sub-Saharan Africa, to 12 births per tract to Dominican women.

3.2. Definition of immigrant groups and ethnic enclaves

We selected all mothers who reported their country of birth as outside of the U.S. on the birth certificate and classified women into regional immigrant groups. Groups with sufficient numbers for stratified analyses were selected: Sub-Saharan African, Chinese, South Central Asian, Non-Hispanic Caribbean, Dominican, Puerto Rican, Mexican, and Central and South American. We defined ethnic enclave for these same immigrant groups as follows. First, we calculated the percent of persons of similar ethnicity, both U.S.-born and foreign-born, residing in the same census tract for each ethnic group using population counts from the 2000 U.S. Census. Next, we examined distributions of ethnic concentration across census tracts for each ethnic group. Distributions for all ethnic groups were highly skewed, with a large number of tracts having <1% ethnic concentration. Each census tract with ethnic concentration at the 90th percentile or higher of the distribution was then classified as representing an ethnic enclave, creating a dichotomous variable for residence in an ethnic enclave (Table 1). For example, for Puerto Ricans, women living in census tracts composed of at least 28.9% persons of Puerto Rican ancestry were classified as living in their ethnic enclave, whereas for South Central Asians, women living in census tracts composed of at least 10.5% persons of South Central Asian ancestry were classified as living in their ethnic enclave (Table 1). This approach allows the ethnic concentration defining an ethnic enclave for each ethnic group to vary depending on its population distribution across census tracts, and was validated previously in a cluster analysis in New York City (Logan et al., 2002). To test the robustness of this measure, we constructed a second dichotomous variable which categorized high ethnic concentration as the 95th percentile or higher. Additionally, we explored the distribution of ethnic concentration in a choropleth map for each immigrant group (ArcGIS).

Table 1. Distribution of ethnic concentration (proportion of persons with shared ethnicity) among census tracts where immigrant women resided, New York City, 2001–2002.

	Min	Max Proportion	Mean Proportion	Median Proportion	90% percentile Proportion	95% percentile Proportion
Subsaharan African	0	0.231	0.015	0.006	0.043	0.058
Chinese	0	0.873	0.065	0.011	0.188	0.291
South Central Asian	0	0.381	0.037	0.014	0.105	0.155
Non-Hispanic Caribbean	0	0.27	0.004	0	0.012	0.020
Dominican	0	0.565	0.084	0.033	0.235	0.303
Puerto Rican	0	0.667	0.115	0.057	0.289	0.363
Mexican	0	0.351	0.039	0.018	0.112	0.154
Central and South American	0	0.320	0.064	0.040	0.157	0.234

3.3. Ascertainment of gestational diabetes

We ascertained cases of gestational diabetes using both the birth record and hospital discharge record. First, we created an indicator for women whose birth certificate stated a diagnosis of gestational diabetes. Second, we created an indicator for women for whom any of the 18 diagnosis codes of the hospital discharge record associated with delivery were ICD-9 code 648.81–648.82, indicating gestational diabetes (Lydon-Rochelle et al., 2005). We then considered women who had gestational diabetes indicated in either source a case. Details on the classification of gestational diabetes in this dataset have been published previously (Janevic et al., 2010a, Savitz et al., 2008). We also explored geographic variation in gestational diabetes using a choropleth map (ArcGIS). The goal of this map was to describe any potential neighborhood variation in gestational diabetes and to support the research objective of examining ethnic enclaves as a neighborhood feature that may contribute to this variation.

3.4. Covariates

Consistent with previous studies (Janevic et al., 2010a, Janevic et al., 2010b, Messer et al., 2006), we measured neighborhood deprivation by deriving an index from a principal components analysis. Twenty-one variables from the 2000 U.S. census from the domains of education, employment, housing, occupation, poverty, and residential stability were entered in the principle component analysis for census tracts in New York City. We used the criterion of retaining variables with factor loadings >0.25, and retained 17 variables (percentage with less than high school education, percentage unemployed, percentage of males not in workforce, percentage of households >1 person per room, percentage of housing renter occupied, percentage of males in a professional occupation, percentage of females in a professional occupation, percentage of males in a management occupation, percentage of females in a management occupation, percentage of individuals with an income below poverty level, percentage of households female-headed with children, percentage of households with income <$30,000 per year, percentage of households on public assistance, percentage of households with no car, median household income, median income of individuals ≥16 years with earnings, median value of owner-occupied units). The minimum loading was 0.53, and the maximum was 0.91). We selected one component *a priori* to serve as the index. Additionally, we examined the eigenvalues and confirmed that one component was appropriate. This component explained 53% of the variance in the 17 socioeconomic variables. We standardized all variables and as necessary reverse coded them so that a high score represented highest level of deprivation. The resulting deprivation scores for census tracts ranged from −3.14 to 2.47.

We obtained other maternal individual-level covariates from the birth certificate and after examining their distributions, categorized them as follows: parity (0, 1, ≥2), pre-pregnancy weight (in quartiles), maternal education (<12 years, 12 years, >12 years), maternal age (continuous), and Medicaid status (yes/no). Maternal height was not available in the birth certificate data so we were not able to calculate pre-pregnancy BMI. Maternal weight was available, but we did not include it as a covariate because we hypothesized that it is on the causal pathway between ethnic concentration and gestational diabetes.

3.5. Statistical analysis

First, we explored sample characteristics by immigrant group. Next, we conducted multivariable analysis to estimate the risk of gestational diabetes for women living in their ethnic enclave relative to those not living in their ethnic enclave using the dichotomous variable of residence in an ethnic enclave as the independent variable, stratified by immigrant group. To account for the clustering of births within census tract, we used a multilevel generalized linear model with a logit link function (PROC GLIMMIX, SAS v. 9.1.3). In the empty multilevel generalized linear model with a binomial response distribution and logit link function, the variance of the random intercept term was 0.15 with a standard error = 0.01, indicating the presence of variation in the log odds of gestational diabetes by census tract and that a multilevel approach is appropriate. Next we calculated odds ratios for dichotomous ethnic neighborhood in relation to the dichotomous outcome of gestational diabetes (yes/no) using the multilevel model. Adjusted odds ratios were then calculated to account for potential confounding by group-level and individual-level covariates. We selected covariates as potential confounders based on examination of a directed acyclic graph that aids in visually specifying the relation between variables and the causal consequences resulting from adjusting for particular covariates (Fleischer and Diez Roux, 2008, Greenland et al., 1999). For example, we did not include maternal pre-pregnancy weight or prenatal care as covariates because in our causal diagram they are on the causal pathway between residence in an ethnic enclave and gestational diabetes. Covariates were introduced to the multilevel model simultaneously and included neighborhood deprivation (continuous), parity, maternal education, and maternal age. All models were estimated using SAS v. 9.1.3.

4. Results

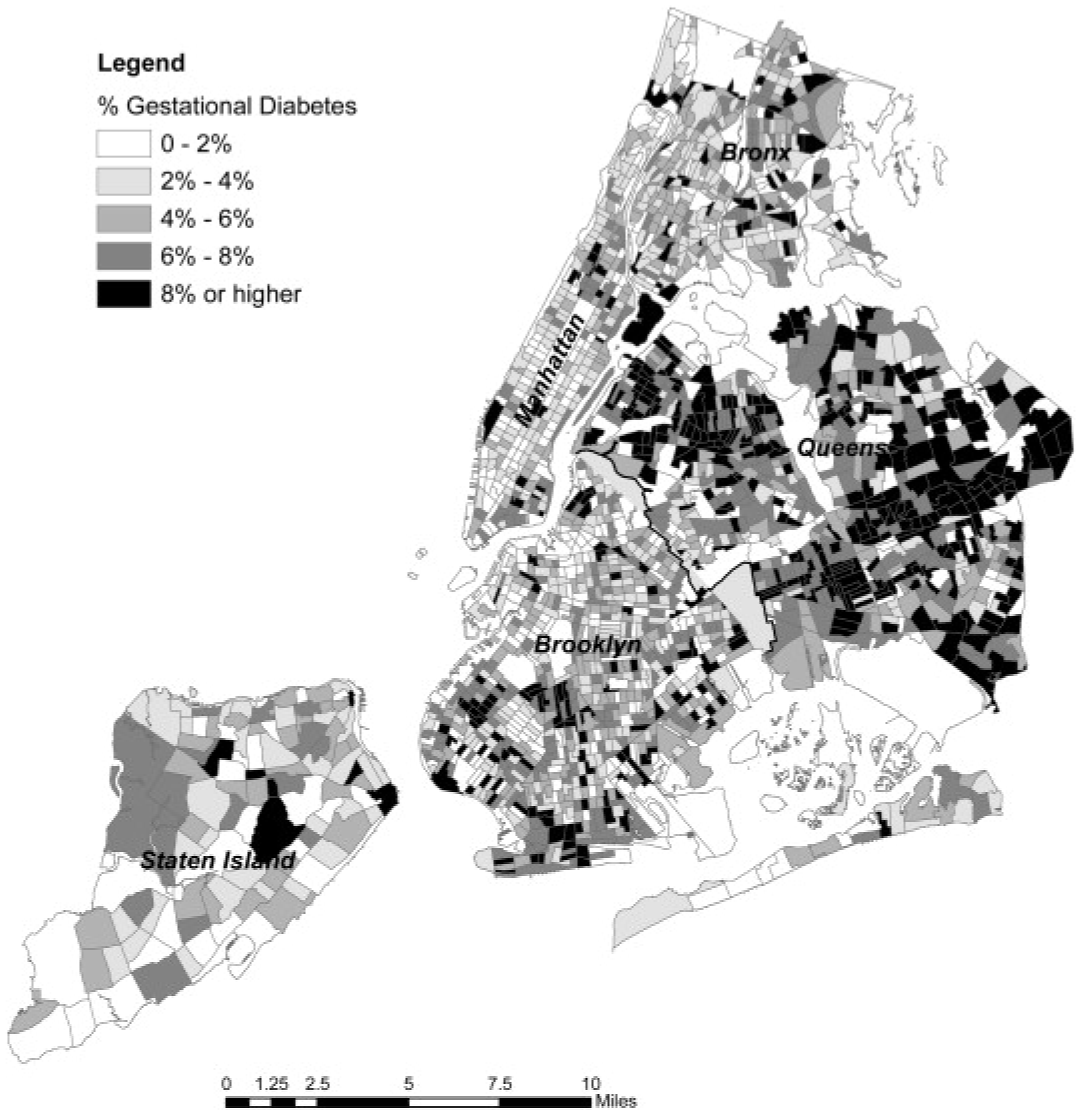

Fig. 1. Percent of births to mothers with gestational diabetes, New York City, 2001–2002.

The percentage of women with gestational diabetes varied geographically, with apparent clustering in Queens (Fig. 1). Neighborhoods with a percentage of gestational diabetes in the highest quintile (8% or higher) were present in every borough. A large number of neighborhoods in the lowest quintile of gestational diabetes percentage were located in Manhattan, Brooklyn, and Staten Island. Gestational diabetes also varied substantially among immigrant groups - the percentage with gestational diabetes was lowest among Sub-Saharan African immigrant women (4.5%), and highest among women from South Central Asia (15.8%). Non-Hispanic Caribbean immigrant women and Chinese immigrant women had similar percentages (6.9% and 7.2%, respectively). Among Latina groups, the percentage of women with gestational diabetes ranged from 4.8% among women from the Dominican Republic to 6.8% among Mexican women (Table 2). Mexican women had the youngest age distribution, with 45.6% less than 25 years, followed by Puerto Rican and Dominican women (38.9% and 30.2%, respectively). A majority of Mexican women had not completed 12 years of education (68%); a sizeable percentage of other Latina groups and Chinese women had not completed 12 years of education. The majority of women in all immigrant groups except for women from Sub-Saharan Africa were Medicaid recipients, with a particularly high percentage found among Mexican women (92.6%) and Dominican women (77.7%). Most women in all groups were first-time mothers, with the exception of Puerto Rican women. The distribution of pre-pregnancy weight was highest among non-Hispanic Caribbean women and Puerto Rican women, with 9.5% and 8.4% of women weighing 200 lbs or more. All groups had a notable percentage of women entering prenatal care after the 1st trimester, and more than 10% of non-Hispanic Caribbean women (11.3%) and South Central Asian women (10.2%) did not receive prenatal care until the 3rd trimester.

Table 2. Sample characteristics by immigrant subgroup, New York City, 2001–2002.

	Subsaharan African	**Chinese**	**South Central Asian**	**Non-Hispanic Caribbean**	**Dominican**	**Puerto Rican**	**Mexican**	**Central and South American**
	***n* = 2951**	***n* = 10,603**	***n* = 9920**	***n* = 16,339**	***n* = 16,423**	***n* = 4432**	***n* = 13,370**	***n* = 20,680**
	%	**%**	**%**	**%**	**%**	**%**	**%**	**%**
Maternal age								
<25 years	3.8	16.3	18.4	23.3	30.2	38.9	45.6	26.7
25–29	22.4	31.8	35.3	24.5	27.9	24.9	29.5	26.7
30–34	44.2	31.8	30.2	25.1	24.0	18.6	17.5	25.1
35–39	23.7	16.2	13.2	20.0	14.3	12.7	6.2	16.7
40 or more	5.9	4.0	3.0	7.1	3.6	4.8	1.2	4.8
Maternal education								
<12 years	3.2	34.1	20.6	16.9	31.6	41.8	68.0	30.2
12 years	21.8	3.3	32.3	40.9	36.2	31.1	26.4	37.1
>12 years	75.0	32.6	32.6	42.3	32.2	27.1	5.7	32.8
Medicaid recipient	30.5	62.9	62.3	60.9	77.7	67.4	92.6	66.9
Previous live births								
0	58.3	51.9	45.2	42.6	37.7	34.4	41.1	41.9
1	32.2	37.6	33.2	30.5	34.7	29.0	30.3	32.4
2 or more	9.5	10.6	21.6	26.9	27.6	36.8	28.6	25.7
Pre-pregnancy weight								
<125 lbs	63.1	68.0	38.0	18.0	28.0	26.4	41.6	32.9
125–150	28.3	26.9	39.6	33.5	41.9	35.6	39.4	40.0
150–175	6.9	4.4	17.0	24.7	19.2	20.8	14.5	17.7
175–200	1.2	0.6	4.2	14.4	9.4	10.7	3.6	6.4
≥200	0.5	0.2	1.3	9.5	3.6	8.4	0.9	3.0
Trimester initiated prenatal care								
1st	72.2	66.3	61.7	61.3	67.7	69.1	58.9	64.7
2nd	20.6	29.0	28.1	27.4	24.4	24.2	32.8	26.7
3rd	7.2	4.5	10.2	11.3	7.9	6.8	8.2	8.6
Gestational diabetes	4.5	7.2	15.8	6.9	4.8	5.7	6.8	6.4

In both unadjusted and adjusted analyses using the 90th percentile definition of ethnic enclave, South Central Asian immigrant women living in ethnic enclaves (neighborhoods comprised of 10.5% or more persons of South Central Asian ethnicity) had a 42% higher odds of gestational diabetes than those living in other neighborhoods (adjusted OR = 1.42, 95% CI = 1.25, 1.61) (Table 3). Associations for other ethnic groups were either weakly protective, null, or weakly harmful, and all spanned 1.0. Sub-Saharan African immigrant women living in ethnic enclaves (neighborhoods comprised of 4.3% or more persons of Sub-Saharan African ethnicity) had over twice the odds of gestational diabetes relative to women in other neighborhoods, although the estimate lacked precision due to the smaller sample size of this group (adjusted OR = 2.11, 95% CI = 0.73, 6.13). Using the 95th percentile to define ethnic enclave, overall results were similar, with no association found among most immigrant groups. The exception was that the adjusted odds ratio comparing Mexican women who living in ethnic enclaves (neighborhoods comprised of 15.4% or more persons of Mexican ethnicity) to those living outside of ethnic enclaves grew in magnitude from 1.12 (95% CI = 0.96, 1.13) to 1.28 (95% CI = 1.08, 1.51)(Table 3). Maps displaying the percentage of South Central Asian and Mexican residents by census tract are presented in Fig. 2 and Fig. 3. Ethnic enclaves for both groups were primarily located in Queens.

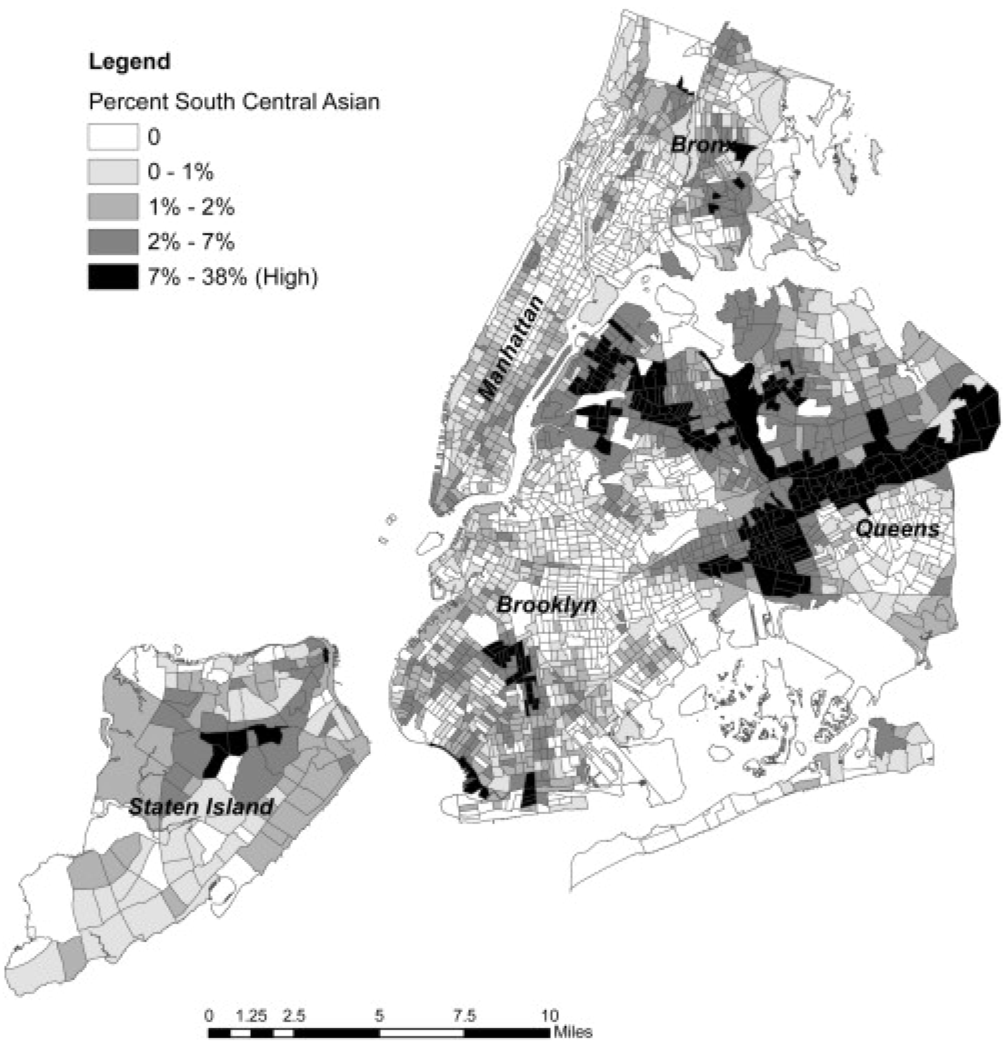

Fig. 2. Percent persons of South Central Asian ethnicity, New York City, 2000.

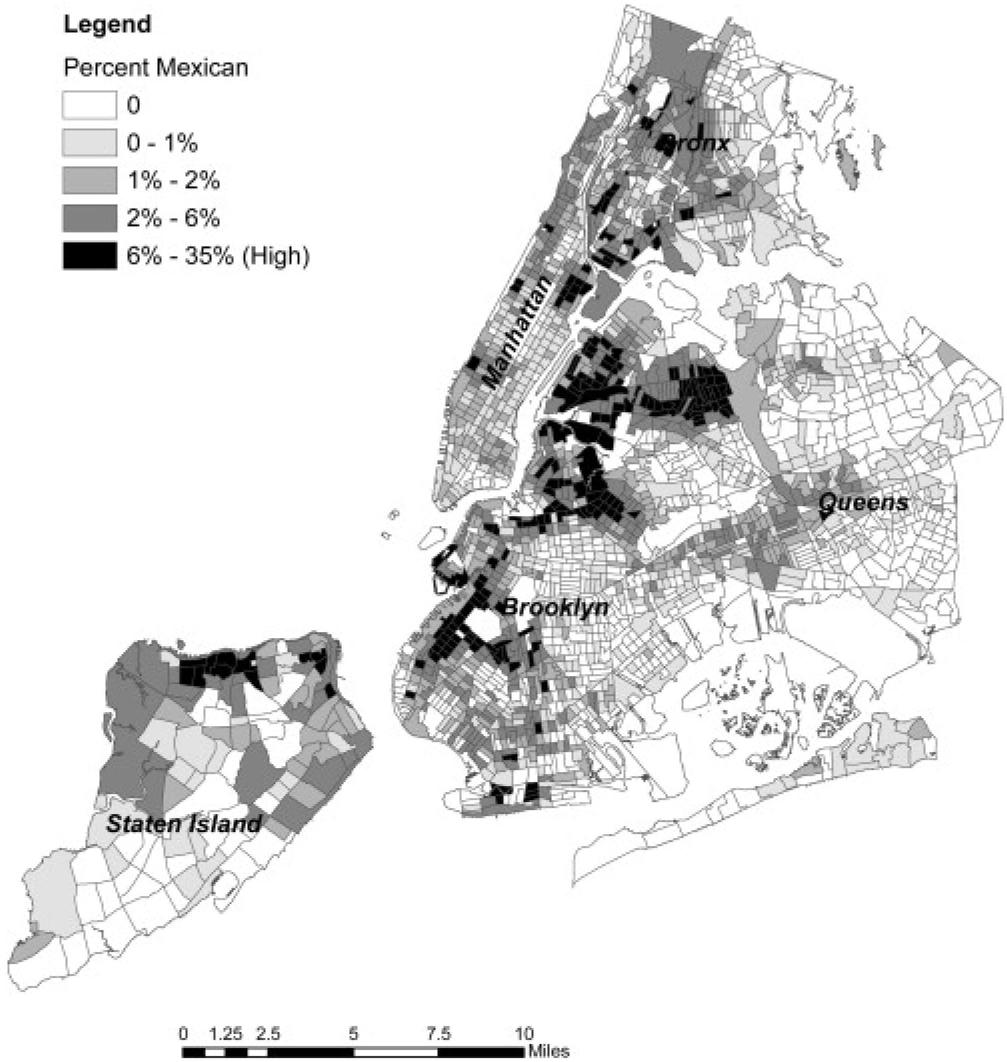

Fig. 3. Percent persons of Mexican ethnicity, New York City, 2000.

Table 3. Unadjusted and adjusted odds ratios estimated by multilevel logistic regression models for living in ethnic enclave and gestational diabetes among immigrant subgroups, New York City, 2001–2002.

Immigrant group	90th Percentile definition of ethnic enclave				95th Percentile definition of ethnic enclave			
	Unadjusted OR[a]	95% CI	Adjusted OR[a,b]	95% CI	Unadjusted OR[a]	95% CI	Adjusted OR[a,b]	95% CI
Sub-Saharan African	2.04	(0.72, 5.79)	2.11	(0.73, 6.13)	1.70	(0.22, 13.13)	1.84	(0.23, 14.9)
Chinese	0.98	(0.84, 1.16)	0.96	(0.81, 1.15)	1.00	(0.85, 1.17)	0.97	(0.81, 1.56)
South Central Asian	1.36	(1.20, 1.54)	1.42	(1.25, 1.61)	1.19	(1.03, 1.37)	1.24	(1.07, 1.44)
Non-Hispanic Caribbean	1.09	(0.77, 1.55)	0.93	(0.65, 1.33)	0.90	(0.48, 1.69)	0.81	(0.43, 1.53)
Dominican	0.90	(0.77, 1.06)	0.87	(0.74, 1.03)	0.90	(0.76, 1.05)	0.86	(0.73, 1.01)
Puerto Rican (Island-born)	0.88	(0.67, 1.15)	0.85	(0.63, 1.15)	1.05	(0.77, 1.44)	1.02	(0.73, 1.43)
Mexican	1.04	(0.89, 1.20)	1.12	(0.96, 1.13)	1.14	(0.97, 1.34)	1.28	(1.08, 1.51)
Central and South American	1.09	(0.94, 1.25)	1.08	(0.94, 1.25)	1.01	(0.86, 1.19)	1.00	(0.85, 1.18)

[a] Referent category for each immigrant group is "women living outside of ethnic enclave".

[b] Adjusted for neighborhood deprivation, percent commercial space, maternal education, insurance status maternal age, parity.

5. Discussion

In contrast to our hypothesis that living in an ethnic enclave is protective of gestational diabetes, we found no association between ethnic enclave residence and gestational diabetes in most immigrant groups. Two exceptions included a greater risk of gestational diabetes among South Central Asian women living in an ethnic enclave defined at the 90th and 95th percentile of ethnic concentration, and among Mexican women living in an ethnic enclave defined at the 95th percentile of ethnic concentration, after adjusting for individual and neighborhood-level covariates. Our finding that among some groups, such as South Central Asian and Mexican women, living in one's ethnic enclave is associated with an increased risk of gestational diabetes contributes to the literature on ethnic enclaves and health by demonstrating that ethnic enclaves are not uniformly protective of health outcomes. Instead, the influence of ethnic enclaves on health may differ depending on the health outcome studied and the relevant health behaviors and norms of the sending country. A closer examination of the existing literature on ethnic enclaves specific to South Asians and Mexicans, as well as the consideration of the unexpected findings in these groups, will inform the discussion on potential mechanisms linking ethnic enclaves to health and motivate future research.

Three previous studies have examined ethnic concentration and pregnancy health among South Asians, one in the UK (Pickett et al., 2009) and two in New York City (Mason et al., 2010, Mason et al., 2011, McLafferty et al., 2012). Among Indian, Bangladeshi, and Pakistani women in the UK, there was an inverse association between ethnic concentration and risk of maternal depression and preterm birth (Pickett et al., 2009); and in New York City, there was a trend toward decreased risk of preterm birth among South Asian women (Mason et al., 2011). A third study in New York City in 2000 examined Bangladeshi women specifically, and found a U-shaped pattern in risk of low birth weight, such that women in low-density and high-density neighborhoods were at increased risk of low birth weight (McLafferty et al., 2012). In the one study examining immigrant Mexican women in the Southwestern U.S., there was no association found between ethnic concentration and infant mortality (Jenny et al., 2001). Other studies examining Mexican women in combination with other Hispanic groups without a focus on immigrant women have found mostly protective effects for adverse birth outcomes (Masi et al., 2007, Mason et al., 2011, Shaw et al., 2010). Although it is difficult to directly compare findings across studies due to differences in definitions of immigrant groups and ethnic neighborhoods, the difference between our findings and that of previous research on pregnancy outcomes among South Asians and Mexicans might be due to unique mechanisms linking ethnic enclaves to an increased risk of gestational diabetes.

We propose three explanations for our findings regarding an increased risk of gestational diabetes in South Central Asian and Mexican ethnic enclaves: cohort of immigration, acculturation, and social isolation. Although these explanations are not testable in the current study, they present important avenues of future research. One explanation is that more recent cohorts of immigrants live in ethnic enclaves, and recent immigration in South Central Asian and Mexican women is associated with an increased risk of gestational diabetes. Recent immigrants may be at higher risk of gestational diabetes for several reasons. First, they might have poorer access to health care, a known risk factor for pregnancy complications. In our study, a relatively low percentage of South Central Asian women and Mexican women initiated prenatal care during the first trimester (61.7% and 58.9%, respectively). Second, both Mexico (Rtveladze et al., 2014) and the South Asian region (Jayawardena et al., 2013) are facing their own obesity epidemics, and immigrants from these regions may bring with them an increased risk of gestational diabetes. Recent research in California found a higher obesity prevalence among immigrant Mexican female adolescents compared to native-born adolescents (Buttenheim et al., 2013), suggesting that the obesity epidemic in Mexico might be reflected in recent immigration to the U.S.A previous study in New York City found that foreign-born South Central Asian and Mexican women had a higher risk of gestational diabetes than U.S.-born women of the same ethnicity (Savitz et al., 2008). Although comparing first generation immigrants to other generations is a weak proxy for cohort of immigration, these findings provide some evidence that there is a lower prevalence of gestational diabetes among more recent cohorts of South Central Asia and Mexican immigrants.

A second explanation for our findings in South Central Asian and Mexican ethnic enclaves is that women in these neighborhoods have lower levels of assimilation and acculturation, and that for these immigrant groups less assimilation and acculturation are associated with a higher risk of gestational diabetes. Although we introduced spatial assimilation theory in relation to protective effects on pregnancy health, to the extent that a behavioral norm is either positively or negatively associated with gestational diabetes among a particular ethnic group, it could have either a protective or harmful effect (Allen and Turner, 2005, Osypuk et al., 2009). For example, the South Central Asian diet is suggested to increase their risk of diabetes due to a high intake of fats, saturated fats, carbohydrates and trans-fatty acids (Misra et al., 2009). Therefore, less assimilated South Central Asian women may be at increased risk of gestational diabetes via dietary patterns. No previous study has examined acculturation in association with gestational diabetes. The literature on acculturation and type 2 diabetes among Latinos and Asians is more developed but inconclusive (Garduño-Diaz and Khokhar, 2012, Pérez-Escamilla, 2011), and the validity of this research has been challenged in a debate regarding how best to conceptualize and measure acculturation in association with health outcomes (Lopez-Class et al., 2011). In addition to individual-level mechanisms related to acculturation such as diet, cultural norms and practices of the sending country create a sociocultural context in ethnic enclaves that influences the risk of gestational diabetes beyond individual-level acculturation. A contemporary view of culture includes aspects such as self-perception, strategies for problem-solving, culture-specific social categories, and institutions such as religious and community organizations (Small et al., 2010). Although a growing literature explores 'culture' as an important determinant of population health (Hruschka and Hadley, 2008), most work on this topic has focused on individual-level phenomenon. Future research might incorporate longitudinal measures of acculturation, measures of neighborhood sociocultural context, and risk of both gestational diabetes and type 2 diabetes.

A third explanation is that if women in South Central Asian and Mexican ethnic enclaves are socially isolated, it might limit the development of "bridging" social capital (Kawachi and Subramanian, 2007). Although immigrant women in ethnic enclaves might benefit from social networks, they may lack weak social ties, or casual acquaintances, which are known to be important to access resources and information (Granovetter, 1983) outside of their isolated immigrant community. In this scenario, the resulting isolation of South Central Asian and Mexican women may limit their access to knowledge resources such as how to access health care during pregnancy. Further, recent research has suggested that residence in an ethnic enclave may result in increased social ties for native but not immigrant women (Viruell-Fuentes et al., 2013), highlighting the importance of studying immigrant women in particular in research on ethnic enclaves and health.

The finding that living in an ethnic enclave is associated with gestational diabetes among South Central Asian and Mexican women may also be due to a lack of validity. For example, there could be a coincident characteristic of South Central Asian and Mexican ethnic enclaves causing increased gestational diabetes. Adjustment in our analysis for neighborhood deprivation, one potential confounding characteristic, did not alter the results. In a post hoc analysis for a separate study, we additionally controlled for the availability of healthy food places (Janevic et al., 2010b), which also did not alter the results (Data not shown). Nonetheless, exploratory mapping of ethnic enclaves showed that the majority of both South Central Asian and Mexican ethnic enclaves are located in Queens, and we cannot rule out the spatial cluster of some unmeasured factor as an alternative explanation.

Given that ethnic enclaves have frequently been found to be protective of immigrant health (Pickett and Wilkinson, 2008), our finding of a lack of a protective effect of ethnic enclaves on gestational diabetes among most of the immigrant groups we examined was unexpected. One potential explanation for our null findings is that the protective mechanisms we proposed as characteristics of ethnic enclaves beneficial to health do not have an impact on gestational diabetes in the same way they do on other health outcomes such as preterm birth or mental health. For example, social support found in an ethnic enclave may buffer stressors such as racism (Bécares et al., 2009) and therefore reduce the risk of a pregnancy outcome sensitive to stress, such as preterm birth, but not necessarily gestational diabetes. Unfortunately we do not have data to test such mediating mechanisms. A second explanation for our null findings is that certain negative influences of ethnic enclaves on gestational diabetes co-occur along with the protective influences, and the balance of these factors may result in a null effect. Many of the reasons proposed to explain an increased risk of gestational diabetes in South Central Asian and Mexican immigrants might also apply to the immigrant groups for which we found null results, but to a lesser a degree, or in combination with other health-enhancing mechanisms. In this case, any of the odds ratios we found could represent a balance of both protective and harmful characteristics of residence in an ethnic enclave. The balance of these factors may vary for each immigrant group, resulting in odds ratios of differing magnitude by immigrant group. The possibility of specific protective or harmful mechanisms depending on the immigrant group highlights the importance of studying ethnic enclaves from a comparative perspective. The unique historical, cultural and linguistic factors associated with each immigrant group may shape health in distinct ways. Only by testing specific mechanisms in future research can both the positive and negative influences of ethnic enclaves on health be elucidated.

Our study has several important strengths. First, we studied the ethnic enclaves of eight specific immigrant groups. The focus on specific immigrant groups as opposed to ethnic groups comprised of both foreign- and U.S.-born women allowed us to consider the sociocultural context of each group to evaluate our findings. The fact that we found null results for some subpopulations and increased odds of gestational diabetes for others demonstrates that broad ethnic groups such as “Hispanic” or “Asian” may obscure important differences in research on ethnic enclaves and health. Second, the linked hospital discharge – birth record data source provided a more valid measure of gestational diabetes than usually available in population-based data. Our focus on gestational diabetes is important because it is understudied in population health research, despite its importance as an early marker of diabetes risk. Finally, our study used a methodological approach to define ethnic enclave based on the concept that for any given ethnic group, there is no uniform percentage of ethnic concentration that can define the existence of an ethnic enclave. This approach is especially important when studying specific immigrant groups, because of the smaller population size. When defining ethnic neighborhoods using broader combined groups such as “Latinos” or “Asians”, ethnic concentration may be distributed linearly and more similar between groups, thus making it appropriate to model ethnic concentration as a linear variable, or to use a common categorization scheme between groups. However, when examining specific immigrant groups as we did in this analysis, ethnic concentration is often non-linear and small percentages can represent an ethnic enclave for a particular group.

A challenge of our analysis common to research on neighborhoods and health was defining the boundaries of a neighborhood and in defining an ethnic enclave (Messer, 2007). Our findings that our results were largely consistent using a 90th percentile or 95th percentile cut-point to indicate high ethnic concentration also suggested that the definition of ethnic neighborhood is not particularly sensitive to the methodology employed. However, there are other limitations to our approach, and it is possible that these limitations could explain our mixed findings. For example, we did not consider the ethnicity of the remaining residents in the census tract. Also, we defined ethnic enclaves using the total population (U.S.-born and foreign-born) of each ethnic group in a census tract. An alternative approach might be to define an immigrant enclave by the percentage of foreign-born residents. We chose the former approach because we were not interested from a theoretical perspective in disentangling the effect of first vs. second generation enclaves in patterning gestational diabetes. Although place-based assimilation patterns for second generation immigrants is an area of growing interest, we were interested in providing the first empirical test of the association between ethnic enclaves and gestational diabetes for immigrant women generally. Further, we felt second or third generation immigrants contribute greatly to the social environment of ethnic enclaves via ethnic institutions and social networks they may provide to more recent immigrants. Nonetheless, future research might examine alternate measures of place-based assimilation in association with women's health. Finally, some scholars have argued that an ethnic enclave is better defined by the density of ethnic businesses, such as shops, restaurants, and other services, as opposed to the density of ethnic neighborhoods (Portes and Jensen, 1992). Ethnic enclaves under this definition, have to our knowledge, not been studied in association with pregnancy outcomes and present an important avenue for future research.

Another limitation commonly cited in the literature on neighborhoods and health is endogeneity, which is the problem that a cross-sectional study cannot identify whether high shared ethnic concentration caused gestational diabetes, or whether women with gestational diabetes simply chose to live in neighborhoods with those attributes (Kawachi and Subramanian, 2007). No cross-sectional study is able to solve this problem, but can be valuable for hypothesis generation and allocation of resources. For example, our findings also call attention to the need for gestational diabetes prevention programs in these “hot-spot” neighborhoods.

In addition to endogeneity, the potential of small Level 1 cluster sizes to result in biased estimates is also a commonly cited issue in neighborhood effects research. In our study, the percentage of census tracts with only one birth ranged from 14% of census tracts among South/Central Americans, to 46% of tracts among Subsaharan Africans (data not shown). One advantage to our use of administrative data is that these percentages are much lower than would be found in most large survey or cohort datasets. Nonetheless, we cannot rule out potential bias, in particular in the model of Subsaharan African women. Whether such bias could either over-estimate or under-estimate parameter estimates is unknown. However, if this bias were to have any effect, it will more likely affect the variance than the effect estimates (Bell et al., 2008).

A final limitation of our study was that there was a limited amount of individual-level data available. More detailed information on the women in our study, such as age and socioeconomic circumstances at immigration, would enable us to test a stronger theoretical model relating ethnic enclaves to gestational diabetes. In particular, a measure of years in the U.S. would allow us to test our counter-hypotheses, many of which center around recent immigration. Another important covariate lacking was pre-pregnancy BMI. The inability to adjust for BMI is not a threat to the validity of our results because it is likely on the causal pathway from ethnic enclave residence to gestational diabetes, and therefore should not be included in covariate-adjusted models. However, measurement of BMI would allow us to conduct analyses to better understand the role of BMI as a causal mechanism. Additionally, BMI is an important outcome in its own right, because preventing obesity in women of child-bearing age is currently the best preventive measure for gestational diabetes (Radesky et al., 2008).

We found that residence in an ethnic enclave was associated with either a higher or no increased risk of gestational diabetes, depending on the immigrant group examined. These findings demonstrate that the influence of ethnic enclaves on health is not universally protective, and may vary depending on the salient health behaviors and norms of the country of origin. Although not conclusive, these results are an important step in building a contextual model for gestational diabetes by considering specific neighborhood features that may be particularly salient to immigrant women. Future research on specific mechanisms linking ethnic enclaves to health is needed. Immigrant–specific studies on contextual factors such as ethnic enclaves help inform the discussion on neighborhoods and health as well as provide useful information for community health programming.

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