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Long-term neighborhood ethnic composition and weight-related outcomes among immigrants: The Multi-Ethnic Study of Atherosclerosis

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Abstract

Weight among immigrants in the United States (US) is lower than among the US-born on average, but higher among long-term immigrants than the newly arrived. Neighborhood coethnic concentration—the proportion of neighborhood residents of the same ethnic background—may influence weight among immigrants via behavioral norms and market-driven community resources. However, the relevant exposure timeframe may be far longer than is captured by existing cross-sectional and short-term studies. Using detailed historical residential address information on 1449 older Latino and Chinese long-term immigrants, we investigated associations of 10–20-year neighborhood coethnic concentration trajectories with current waist circumference and weight-related behaviors (diet, physical activity, and sedentary time). Among Chinese participants, compared to persistent low coethnic concentration, increasing coethnic concentration was associated with higher waist circumference (difference = 1.45 cm [0.51, 2.39]). In contrast, both increasing coethnic concentration and persistent high coethnic concentration were associated with a healthier diet. Among Latino participants, trajectories characterized by higher coethnic concentration were associated with higher waist circumference (e.g., difference = 2.11 cm [0.31, 3.91] for persistent high vs. persistent low) and low physical activity. Long-term patterns of

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neighborhood coethnic concentration may affect weight-related outcomes among immigrants in complex ways that differ by ethnicity and outcome.

Keywords

waist circumference; neighborhoods; immigrants; diet; physical activity

Latino and Asian immigrants in the United States (US) have lower weight than their US-born counterparts on average.[1] However, some research also shows that weight among immigrants is higher the longer they live in the US;[2] one contributing factor may be that immigrants tend to live in neighborhoods with higher concentrations of other immigrants and residents who share their ethnic background than the US-born.[3] These neighborhoods may differ from others in ways that affect weight and weight-related behaviors, such as food availability and walkability.[4–10] The presence of other immigrants in a neighborhood may also affect psychosocial determinants of weight-related behaviors, such as by buffering residents against discrimination or providing access to larger social networks.[4,11]

A small body of mostly cross-sectional research has examined associations between neighborhood immigrant or ethnic composition and weight status among Latinos or Asians.[12–18] However, these studies have largely neglected the fact that changes in neighborhood composition experienced by immigrants over many years, either from residential moves or from neighborhoods changing while residents remain in place, may result in different longitudinal trajectories of neighborhood ethnic composition that affect current weight differently. Cross-sectional or short-term studies relating current neighborhood conditions to weight cannot capture this influence and therefore may not accurately represent neighborhood influences on weight. Rather, particularly among long-term immigrants, current weight-related outcomes may reflect the accumulated influence of neighborhood conditions experienced over many years.

We addressed this research gap by 1) characterizing long-term patterns of neighborhood ethnic composition among immigrants and 2) testing associations of these patterns, which may represent a more appropriate timeframe than past studies for examining how neighborhood ethnic composition influences weight, with weight-related outcomes. Specifically, we used detailed historical residential address information to investigate associations of neighborhood ethnic composition trajectories during the previous 10–20 years with current waist circumference, body mass index (BMI), and weight-related risk behaviors (poor diet, low physical activity, and high sedentary time) in a multi-site cohort of older Asian and Latino long-term immigrants. Our measure of neighborhood ethnic composition was neighborhood coethnic concentration, the percent of the population in each participant's census tract that was of the same ethnic background as the participant.

Using these data we examined longitudinal trajectories of neighborhood coethnic concentration that incorporated information about both the level of neighborhood coethnic concentration and patterns of change over time. We hypothesized that trajectories characterized by higher neighborhood coethnic concentration or a pattern of increasing neighborhood coethnic concentration over time would be associated with healthier weight-

related outcomes, while lower neighborhood coethnic concentration or a pattern of decreasing neighborhood coethnic concentration over time would be associated with unhealthier weight–related outcomes. Our hypotheses drew on classical sociological assimilation theory, which implies that immigrants assimilate to the dominant US culture over time, and that this assimilation may be accompanied by behavioral changes leading to higher weight.[3,5,19] We also drew on the ethnic enclave hypothesis, which describes distinct economic markets operating in immigrant neighborhoods that may contribute to differences in the built, economic, and social environments that facilitate healthier behaviors.[20] From a socioecological perspective, because of the distinct built and social environments in neighborhoods with different levels of coethnic concentration, long-term residence in neighborhoods with lower or decreasing coethnic concentration may cause or hasten assimilative changes to residents' weight and weight-related behaviors. Specifically, *residential spatial assimilation*, a pattern of decreasing neighborhood coethnic concentration over time, may contribute to the process of *individual-level assimilation*.

METHODS

Study Population

We used data from the Multi-Ethnic Study of Atherosclerosis (MESA), a cohort study of adults aged 45–84 years from four race/ethnicity groups (non-Latino White, non-Latino Black, Latino, and Chinese) who were free of clinical cardiovascular disease at baseline. Study design details are available elsewhere.[21] Briefly, participants were recruited from six sites (Forsyth County, NC; New York City, NY; Baltimore, MD; St. Paul, MN; Chicago, IL; and Los Angeles, CA) using population-based methods.[21] Baseline exams were conducted in 2000–2002, with four follow-up waves in 2002–2003, 2004–2005, 2006–2007, and 2010–2012. The study was approved by the Institutional Review Boards at each site and all participants gave written informed consent. Neighborhood information was drawn from the ancillary MESA Neighborhood Study.

Our analysis used pooled data from all five study waves, i.e., each participant contributed 1–5 separate observations. Our sample included MESA participants who reported being foreign-born and of Latino (N = 899) or Chinese (N = 697) ethnicity (there were few foreign-born non-Latino White or Black participants). We excluded 3 participants who lived outside of MESA sites with dedicated sampling of Chinese and Latino participants (CA and IL for Chinese participants; CA, MN, and NY for Latino participants). Because our goal was to examine long-term neighborhood conditions, participants were not eligible to contribute observations to our analysis sample until they had lived in the US at least 10 years. The final analysis sample included 1449 immigrants at baseline (636 Chinese and 813 Latino) who contributed a total of 6,269 observations over the course of 5 MESA follow-up exams. Models for diet, physical activity, and sedentary time contained fewer observations because this information was not collected at every study wave, as described below.

Measures

Outcomes—All outcomes were coded so that higher values denote higher risk. Anthropometric information was measured by study staff at each study exam using standard

procedures.[21] Waist circumference (WC) was measured in centimeters and BMI was calculated as (weight [kg])/(height [m])^2. We present results for BMI in supplementary tables but focus on waist circumference for our main results because of evidence that WC may be a better measure of adiposity and predictor of cardiovascular risk than BMI in older populations.[22,23]

Diet information was collected in study waves 1 and 5 only, using a food frequency questionnaire based on the Insulin Resistance Atherosclerosis Study instrument and modified to include foods typically eaten in Chinese populations.[21] Our measure of diet was the Healthy Eating Index-2005 (HEI), a summary dietary quality score developed by the US Department of Agriculture (USDA) in 2005.[24] Details have been published elsewhere[24] but briefly, the HEI was developed by a multiagency workgroup convened by the USDA's Center for Nutrition Policy and Promotion and designed to align with the USDA's MyPyramid food guidance system. It uses a point system to characterize consumption of the following 12 dietary components: total fruit, whole fruit, total vegetables, dark green and orange vegetables and legumes, total grains, whole grains, milk, meat and beans, oils, saturated fat, sodium, and calories from solid fat, alcohol, and added sugar. The components are measured in terms of density relative to total energy consumption though the HEI is not a measure of total calorie consumption. We reverse-coded the HEI to create a dietary score ranging 0–100, with higher scores denoting poorer diet quality.

Physical activity information was collected in study waves 1, 2, 3, and 5, using a 28-item survey adapted from the Cross-Cultural Activity Participation Study[25] asking participants about the frequency, duration, and intensity of their participation in a variety of activity categories (e.g., work, walking, sports) during a typical week in the past month.[17] We used two different measures of physical activity, both dichotomized because of highly skewed distributions. The first was metabolic equivalent task (MET) units per week of moderate or vigorous activity; our outcome was being in the lowest tertile of activity (vs. the other two higher tertiles). The second was weekly sedentary minutes, measured using three questions from the physical activity survey asking participants about time spent sitting or reclining and watching television; reading, knitting, sewing, visiting, doing nothing, or using the computer recreationally; and working with light effort and while sitting. Our outcome was being in the highest tertile of sedentary time (vs. the lower two tertiles). Models for sedentary time include only study waves 1–3 because of inconsistencies in the questions in wave 5.

Long-term neighborhood coethnic concentration—Residential history information was collected from a questionnaire during either the 2nd or 3rd study wave. Participants were asked for their address on January 1980 and all subsequent addresses and dates of residence through the date of the questionnaire. If they were unable to provide a complete address, they were asked to provide the street name and closest cross-street.[26] Participants' addresses during MESA follow-up were recorded and geocoded using TeleAtlas EZ-Locate web-based geocoding software; only US addresses were included. Seventy percent of retrospectively reported addresses and 96% of follow-up addresses could be geocoded to an exact address; 91% and 99% were successfully linked to census-tract-based neighborhood measures, respectively.

We used measures of racial/ethnic concentration from the 1980–2010 decennial censuses to create our measure of neighborhood coethnic concentration, using census tracts as proxies for neighborhoods. Neighborhood coethnic concentration was defined as the percent of tract residents of Chinese origin for Chinese participants, and the percent of Latino-origin tract residents for Latino participants. We interpolated neighborhood coethnic concentration using separate tract-specific linear slopes for 1980–1990, 1990–2000, and 2000–2012, using Census 2010 tract boundaries.[18,27] Measures were assigned to each observation (i.e., person-visit) based on their residential address during each month from January 1980 through the exam date.

We then used latent trajectory modeling (SAS TRAJ procedure) to classify observations into longitudinal linear trajectories of neighborhood coethnic concentration; each observation was assigned to the trajectory for which it had the highest predicted probability.[28,29] Therefore, for each observation, the estimated co-ethnic concentration trajectory spanned from 10 up to the previous 20 years, depending how long the participant had resided in the US as of that study wave. Our approach accounted for within-person changes in coethnic concentration trajectory over time since the trajectory was allowed to vary across outcome observations pertaining to the same person. We modeled the trajectories for the Chinese and Latino samples separately to allow for group differences in neighborhood coethnic concentration distributions. We used the Bayesian Information Criterion (BIC) and visual inspection to choose the number of distinct trajectories.[28] Further details are provided in the Supplement.

In a sensitivity analysis, we created an alternative measure of neighborhood coethnic concentration using country-specific definitions for Latino participants where possible, i.e., tract percent Mexican, Puerto Rican, and Cuban, for Mexican, Puerto Rican, and Cuban participants, respectively. As in the original measure, neighborhood coethnic concentration was defined as percent Latino for participants of other Latino backgrounds because no country-specific measures were available (45% of Latino participants), and percent Chinese for Chinese participants. We repeated the latent trajectory modeling and outcome models for the entire sample using this alternative measure.

Covariates—Outcome models adjusted for gender, years of education (centered at 12), and time-specific measures of age and age squared (continuous, mean-centered at 64), marital status (whether currently married or living with a partner), years lived in the US, tract-level median household income (continuous, centered at $30,000), study site, and study wave. We created the neighborhood median household income measure using the same interpolation method as neighborhood coethnic concentration, except that because of changes in the availability of census variables for socioeconomic status, we used the 1980–2000 decennial censuses and the 2006–2010 American Community Survey rather than the 1980–2010 decennial censuses. Additional adjustment for participant household income did not affect results.

Analysis

To handle missing data, we used multiple imputation with 25 imputations using a chained equations approach in IVEware software.[30] We used ethnicity-specific generalized estimating equation (GEE) regression with robust standard errors to estimate associations of neighborhood coethnic concentration trajectories with each outcome separately while accounting for correlated observations pertaining to the same participant.[31,32] There was minimal clustering of participants within census tracts so our models did not account for this level of correlation. We used linear regression for continuous outcomes (waist circumference, BMI, diet score) and modified Poisson regression to calculate prevalence ratios for moderate/vigorous physical activity and sedentary time.[33,34]

RESULTS

In both the Chinese and Latino samples, we identified 6 distinct trajectories of long-term neighborhood coethnic concentration (Figure 1). However, the types of trajectories differed between the two groups. Among Chinese participants, there were three trajectories of stable neighborhood coethnic concentration (persistently very low, persistently low, and persistently moderately high), one trajectory characterized by decreasing neighborhood coethnic concentration over time, and two trajectories characterized by increasing neighborhood coethnic concentration over time. Among Latino participants, all 6 trajectories were characterized by stable neighborhood coethnic concentration, i.e., there were no trajectories demonstrating either increasing or decreasing coethnic concentration over time. Sixty-four percent of participants were classified into the same trajectory across all study waves; 31% and 5% had observations assigned to 2 and 3 different trajectories, respectively. Because associations with the outcomes were very similar for the persistently low and persistently very low coethnic concentration trajectories among Chinese participants, we combined these trajectories into a single “persistently low” group in final models for ease of interpretation. Similarly, we combined the two trajectories characterized by increasing coethnic concentration among Chinese participants. Among Latino participants we combined the persistently very low and persistently moderately low trajectories into a single “persistently low” group, and the persistently moderately high, persistently high, and persistently very high trajectories into a single “persistently high” group. Results modeling all 6 trajectories separately can be found in the Supplement (Table S2).

Table 1 shows sample characteristics of the original and imputed samples. The variable with the highest degree of missingness was years lived in the US (11%); variable distributions in the original and imputed samples were nearly identical. The sample was about half male, mean age was 65 years (not shown), and most participants were living with a spouse or partner. Twenty-three percent of Chinese and 52% of Latinos had less than a high school degree. Seventy-seven percent of Chinese and 73% of Latinos reported speaking only Chinese or Spanish at home, respectively. Fifty-nine percent of Chinese and 91% of Latinos had high or very high waist circumference (≥ 80 cm among women, ≥ 90 cm among men).[35] Chinese participants had lived fewer years in the US than Latino participants (33% vs. 67% who had lived in the US ≥ 30 years) and were also more mobile (42% vs. 21% with ≥ 4 different addresses during the entire follow-up period).

Among Chinese participants, 58% of the sample experienced stable neighborhood coethnic concentration over time (48% persistently low and 10% persistently high), 36% experienced increasing coethnic concentration, and only 6% experienced decreasing coethnic concentration (Table 2). Among Latinos, among whom all trajectories represented stable levels of neighborhood coethnic concentration over time, 16% of the sample experienced very low coethnic concentration, 19% moderately low, 20% moderately high, and 44% high.

Table 2 shows bivariate associations between neighborhood coethnic concentration trajectories and the other variables. In both groups, participants who experienced persistently low coethnic concentration trajectory were more likely to have high education and income. Chinese participants in the persistently low trajectory were also more likely to have lived longer in the US, but this was not the case among Latino participants. In addition, among Chinese participants, those in the trajectories characterized by stable coethnic concentration (persistently low and persistently high) were more likely to have remained at a single address than those in the other trajectories. Among Latino participants, those in trajectories characterized by higher coethnic concentration were more likely to have remained at a single address.

Table 3 shows adjusted associations of the outcomes with neighborhood coethnic concentration trajectories, with persistently low coethnic concentration as the referent group. Among Chinese participants, increasing coethnic concentration was associated with higher mean WC compared to the persistently low trajectory, contrary to our hypothesis (difference = 1.45 cm [0.51, 2.39]). However, both persistent moderately high coethnic concentration and increasing coethnic concentration were associated with a healthier (i.e., less unhealthy) diet score (difference −2.35 cm [−4.16, −0.54] and −1.29 cm [−2.57, −0.01], respectively). Neighborhood coethnic concentration trajectories were not associated with physical activity or sedentary time.

Among Latino participants, compared to persistently very low coethnic concentration, all other trajectories were associated with higher mean WC (difference = 2.28 cm [0.74, 3.81] for persistent moderately low, difference = 2.20 cm [0.38, 4.02] for persistent medium, difference = 2.11 cm [0.31, 3.91] for persistent high). Unlike among Chinese participants, neighborhood coethnic concentration trajectories were not associated with diet score among Latino participants. However, compared to persistently very low coethnic concentration, the other trajectories were associated with low physical activity (PR [prevalence ratio] = 1.42 [1.07, 1.88] for persistent moderately low, PR = 1.41 [1.02, 1.95] for persistent medium, PR = 1.43 [1.04, 1.97] for persistent high). Neighborhood coethnic concentration trajectories were not associated with BMI in either group, although there was suggestive evidence that increasing coethnic concentration was associated with higher BMI among Chinese participants (Supplement, Table S3).

In the sensitivity analysis using country-specific measures of neighborhood coethnic concentration for participants from Mexico, Puerto Rico, and Cuba, the latent trajectory modeling among Latino participants produced 6 trajectories; unlike in the main analyses, these included a trajectory representing increasing coethnic concentration and a trajectory representing decreasing coethnic concentration (see Supplement, Figure S1). As in the main

analyses, results were consistent when two trajectories representing persistent high coethnic concentration were combined, as well as two trajectories representing stable low coethnic concentration, so we present these more parsimonious results (Supplement, Table S4). Results were generally consistent in direction with the main results but differed in magnitude and statistical significance. Unlike in the main results, neighborhood coethnic concentration trajectories were not associated with waist circumference and only increasing coethnic concentration was associated with low physical activity (PR = 1.28 [1.02, 1.61]). In addition, compared to persistent low coethnic concentration, persistent high coethnic concentration was associated with a less unhealthy diet (difference in unhealthy diet score = −1.57 [−2.82, −0.33]) and lower prevalence of sedentarism (PR = 0.76 [0.62, 0.94]).

DISCUSSION

In a cohort of immigrant older adults, long-term neighborhood coethnic concentration trajectories differed by ethnic group (Chinese or Latino). Notably, in our sample of older Latino long-term immigrants, all identified trajectories represented stable levels of coethnic concentration over time. We were therefore unable to test hypotheses about how long-term increasing patterns of increasing or decreasing coethnic concentration relate to waist circumference and associated behaviors (diet, physical activity, and sedentary time) among Latino participants.

More generally, both this result among Latinos and the fact that Chinese study participants were more likely to experience long-term increasing coethnic concentration than decreasing coethnic concentration are at odds with classical spatial assimilation theory, which hypothesizes that immigrants tend to experience residential spatial assimilation over time as one dimension of acculturation to the dominant US culture.[3,5,19] Rather, it supports segmented assimilation theory, which hypothesizes that immigrants may assimilate to different segments of the US population rather than integrating to a monolithic middle-class white society.[5] For example, evidence points to a pattern of increasing Latino residential segregation in metropolitan areas, especially in areas that have recently become immigrant destinations.[36] There was also enormous growth overall of the Chinese population in the US during this period, from 384,000 in 1980 to over 2 million in 2013.[37]

Associations of long-term neighborhood coethnic concentration trajectories with the outcomes differed by ethnic group (Chinese or Latino), and in some cases were contrary to our initial hypotheses. Our results for WC were contrary to our hypotheses in both groups. Among Chinese participants, compared to persistent low coethnic concentration, increasing coethnic concentration over time was associated with higher waist circumference while persistent high and decreasing coethnic concentration were not associated with waist circumference. Among Latino participants, all trajectories characterized by higher neighborhood coethnic concentration were associated with higher waist circumference. Past research has related decreasing neighborhood coethnic concentration with concurrent small increases in waist circumference in MESA participants but this result was most pronounced among recent immigrants;[18] the processes leading to short-term weight changes among recent immigrants may differ from those leading to longer-term weight and associated behaviors in long-term immigrants.

One contributing factor to our results may be that neighborhood coethnic concentration trajectories reflect qualitative differences in neighborhood conditions not captured in our analysis. For example, previous research in MESA found that Chinese and Latino immigrants living in neighborhoods with high neighborhood coethnic concentration ("immigrant enclaves") reported better diets and availability of healthy foods, but also worse walkability, fewer physical activity resources, and lower levels of social cohesion and civic engagement.[10] Our results may also be subject to residual confounding by neighborhood socioeconomic circumstances, despite the adjustment for neighborhood income in our models. In this case, potential benefits of living in high-coethnic-concentration neighborhoods may have been offset by neighborhood socioeconomic disadvantage. The relationship between neighborhood coethnic concentration and the healthfulness of neighborhood environments may also differ by location. A recent study of census tracts in Texas found that a higher proportion of foreign-born residents was associated with a healthier food environment in border areas but the opposite in non-border settings.[38] In addition, neighborhood conditions may influence behaviors differently in different immigrant groups or locations.[22]

Our findings for WC among Chinese participants are also seemingly at odds with our results that increasing and persistent high coethnic concentration were associated with better diet quality. These results highlight the complexity of how weight, behaviors, and neighborhood contexts are related. Of note, the HEI, while somewhat correlated with energy consumption, is by design a measure of diet quality, not energy consumption.[24] Diet was also measured concurrently with waist circumference; current diet may differ from past dietary practices that contributed to current weight. Taken alone, our result for diet among Chinese participants is consistent with previous cross-sectional research relating higher current neighborhood coethnic or immigrant concentration with better diet,[10,39–41] and suggests that past neighborhood conditions may also contribute to current dietary practices among some immigrant groups.

Very few studies have examined neighborhood ethnic composition in relation to physical activity among immigrants. Our result, that long-term neighborhood coethnic concentration was inversely related to moderate/vigorous physical activity only among Latino immigrants, is consistent with cross-sectional MESA baseline results.[10] Studies of individual-level acculturation have found that acculturation is associated with more leisure-time physical activity and a greater likelihood of meeting overall physical activity recommendations, but also more sedentary behavior.[42–45] In our analysis, point estimates were suggestive of associations between higher coethnic concentration and less sedentary behavior among Latinos, but the result was statistically significant only in supplemental analyses incorporating country-specific measures of coethnic concentration.

Our study was subject to several limitations. The MESA cohort was not designed to be representative of the older US population, although demographics among the Latino and Chinese samples are similar to US averages.[10] We relied on interpolated neighborhood coethnic concentration measures and on retrospectively recalled historical address information for dates before the MESA baseline study wave. Although the diet and physical activity questionnaires adapted in MESA have been widely used and related to disease

outcomes,[17,46,47] the difficulty in accurately measuring these outcomes, as well as the anthropometric outcomes, may have hindered our ability to detect associations.[17,46,47] We were not able to incorporate changes over time in measures of individual-level assimilation, such as language preference, that may mediate effects of neighborhood coethnic concentration on weight-related outcomes. Finally, as mentioned above, we did not capture potentially important qualitative differences between neighborhoods with similar coethnic concentration. Recent work in MESA has shown that specific aspects of the neighborhood built environment, such as walkability and the availability of recreational facilities, may modify weight change among immigrants.[22] Future research may also incorporate more explicit measures of distinct neighborhood-level economic markets, such as the number of immigrant-owned businesses.

Despite increasing attention to a life course perspective in public health, little research has considered how long-term neighborhood contexts influence residents' health. Our study provides evidence that not only current but also past neighborhood exposures may be important for health and health behaviors among immigrants. This is a promising approach to help us understand the multilevel mechanisms behind well-documented increases in cardiovascular risk factors associated with longer duration of US residence among immigrants.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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- Long-term neighborhood ethnic composition was related to immigrants' weight outcomes
- Chinese and Latino immigrants in high-coethnic neighborhoods had higher waist circumference
- Latino immigrants in high-Latino neighborhoods reported less physical activity
- Chinese immigrants in increasing or high coethnic neighborhoods had healthier diets

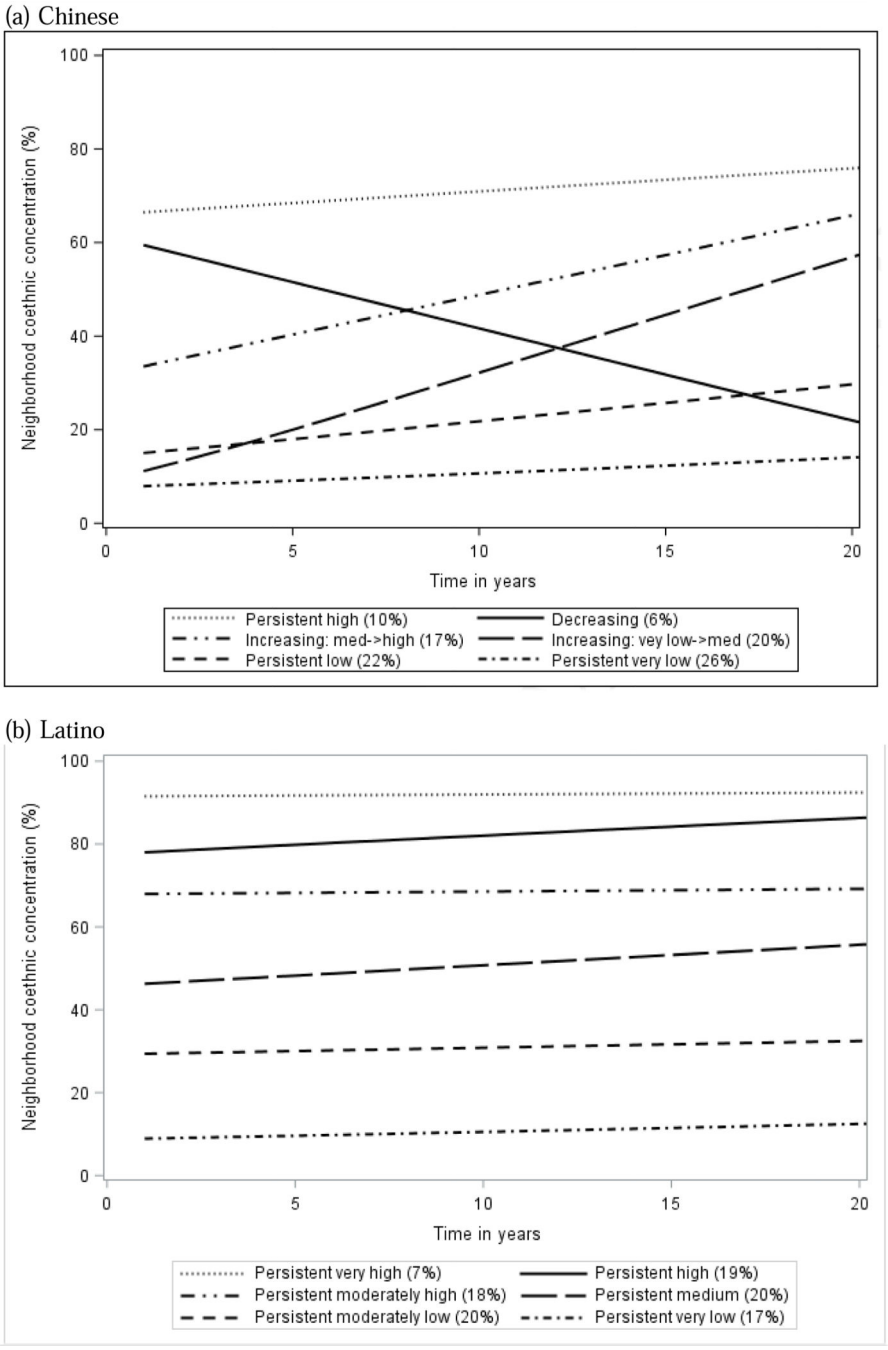

Figure 1.

Trajectories of neighborhood coethnic concentration over time, by ethnicity

Neighborhood coethnic concentration as defined as the percent of census tract residents of Chinese heritage for Chinese participants, and tract percent Latino for Latino participants. Percents are the percent of observations assigned to the trajectory.

Table 1.

Sample characteristics[a], by ethnicity

	Total			Chinese			Latino		
	Original		Imputed	Original		Imputed	Original		Imputed
	N	%[b]	%	N	%[b]	%	N	%[b]	%
Total number of observations	6269	--	--	2705	--	--	3564	--	--
Male	2925	47	47	1332	49	49	1593	45	45
Age (years)									
45–54	1190	19	19	478	18	17	712	20	20
55–64	1961	31	31	837	31	31	1124	32	32
65–74	1885	30	30	817	30	31	1068	30	30
75–84	1082	17	17	506	19	19	576	16	16
85–93	151	2	2	67	2	3	84	2	2
Education									
Less than high school/GED	2477	40	40	624	23	23	1853	52	52
High school/GED	1074	17	17	426	16	16	648	18	18
Some college, associate's degree	1274	20	20	551	20	20	723	20	20
≥ Bachelor's degree	1444	23	23	1104	41	41	340	10	10
Income[c]									
<$12,000	1447	23	23	599	22	22	848	24	24
$12,000–24,999	1839	29	29	723	27	26	1116	31	31
$25,000–39,999	1259	20	20	430	16	16	829	23	23
$40,000–74,999	994	16	16	445	16	17	549	15	16
$75,000+	724	12	12	508	19	19	216	6	6
Missing	6	0.1	--	0	0	--	6	0.2	--
Married or living with a partner[d]	4316	69	69	2183	81	81	2133	60	60
Years lived in US									
10–19	1234	22	21	837	33	32	397	13	13
20–29	1470	26	27	865	35	35	605	19	20
≥ 30	2905	52	52	803	32	33	2102	68	67
Missing	660	11	--	200	7	--	460	13	--
Language spoken at home									
English	513	8	8	107	4	4	406	11	11
Chinese/Spanish	4707	75	75	2088	77	77	2619	73	73
English and Chinese/Spanish	693	11	11	192	7	7	501	14	14
Other	356	6	6	318	12	12	38	1	1
Number of addresses									
1	1645	26	27	337	12	13	1308	37	37
2	1431	23	23	589	22	22	842	24	24
3	1268	20	20	613	23	23	655	18	18
≥ 4	1925	31	30	1166	43	42	759	21	21

	Total			Chinese			Latino		
	Original		Imputed	Original		Imputed	Original		Imputed
	N	%[b]	%	N	%[b]	%	N	%[b]	%
Site									
CA	2819	45	45	1614	60	59	1205	34	34
IL	1091	17	17	1091	40	41	---	---	---
MN	652	10	10	---	---	---	652	18	18
NY	1707	27	28	---	---	---	1707	48	48
Waist circumference (cm)									
Normal (< 80 women, < 90 men)	1450	23	23	1104	41	41	346	10	10
High (80–87 women, 90–101 men)	1923	31	31	921	34	34	1002	28	28
Very high (≥ 88 women, ≥ 102 men)	2896	46	46	680	25	25	2216	62	62

GED = general equivalency diploma; US = United States of America

[a] Pooled sample includes observations from 1449 individuals (636 Chinese and 813 Hispanic).

[b] Percents do not including missing values.

[c] Question not asked in exam 4. Values imputed with nonmissing value closest in date.

[d] Question not asked in exam 2. Values imputed with nonmissing value closest in date.

Table 2.

Sample characteristics[a], by ethnicity and neighborhood coethnic concentration trajectory

	Chinese				Hispanic			
	Persistent low	Persistent moderately high	Decreasing	Increasing	Persistent very low	Persistent moderately low	Persistent medium	Persistent high
	%	%	%	%	%	%	%	%
Total	48	10	6	36	16	19	20	44
Male	48	43	51	52	46	46	43	45
Age (years)								
45–54	20	6	15	17	20	26	23	15
55–64	33	26	41	28	30	35	32	31
65–74	31	38	32	28	27	25	29	34
75–84	15	25	11	23	19	13	15	18
85–93	1	5	1	4	5	1	2	2
Education								
Less than high school/GED	15	36	32	28	31	45	51	63
High school/GED	12	26	15	18	14	24	20	16
Some college, associate's degree	20	13	20	22	31	22	21	16
≥ Bachelor's degree	53	25	32	31	24	9	8	5
Income[b]								
<$12,000	17	35	21	25	18	25	19	27
$12,000–24,999	19	30	34	34	20	30	33	35
$25,000–39,999	15	17	15	17	24	22	26	23
$40,000–74,999	20	8	21	13	20	17	17	12
$75,000+	29	10	10	11	18	7	5	2
Married or living with a partner[c]	85	65	80	79	59	55	63	61
Years lived in U.S.								
10–19	24	36	30	42	16	19	12	10
20–29	32	35	44	36	18	22	18	22
≥ 30	43	30	26	22	66	59	70	68

	Chinese				Hispanic			
	Persistent low	Persistent moderately high	Decreasing	Increasing	Persistent very low	Persistent moderately low	Persistent medium	Persistent high
	%	%	%	%	%	%	%	%
Number of addresses								
1	18	15	1	7	29	25	42	43
2	24	26	18	18	21	18	24	27
3	19	26	30	25	21	24	16	16
≥ 4	39	33	51	50	29	33	18	14
Site								
CA	36	58	70	88	13	24	32	47
IL	64	42	30	12	--	--	--	--
MN	--	--	--	--	59	38	3	1
NY	--	--	--	--	29	38	65	52
Waist circumference (cm)								
< 80 women, < 90 men (Normal)	44	33	38	38	12	8	10	9
80–87 women,90–101 men (High)	34	37	35	33	27	27	32	27
≥ 88 women, ≥ 102 men (Very high)	21	29	27	29	61	65	58	64
Body mass index (kg/m^2)								
< 18.5 (Underweight)	3	4	4	3	1	0.0	0.1	0.19
18.5–24.9 (Normal)	64	59	58	59	22	17	18	18
25–29.9 (Overweight)	30	32	32	31	41	42	45	46
≥ 30 (Obese)	3	6	7	7	36	42	37	36

[a]Pooled sample includes observations from 1449 individuals (636 Chinese and 813 Hispanic). Percents are from multiply imputed sample.

[b]Question not asked in exam 4. Values imputed with nonmissing value closest in date.

[c]Question not asked in exam 2. Values imputed with nonmissing value closest in date.

Table 3.

Adjusted associations[a] between trajectories of neighborhood coethnic concentration and weight-related outcomes, by ethnicity

	Waist circumference (cm)[b]		Unhealthy diet score[b,d]		Moderate/vigorous physical activity (lowest tertile of MET-minutes/week)[c,e]		Sedentary time (highest tertile of minutes/week)[c,f]	
Trajectory	**Diff**	**95% CI**	**Diff**	**95% CI**	**PR**	**95% CI**	**PR**	**95% CI**
Chinese								
Persistent low	Ref		Ref		Ref		Ref	
Persistent moderately high	0.90	(−0.47, 2.27)	−2.35	(−4.16, −0.54)	0.90	(0.67, 1.22)	1.05	(0.73, 1.51)
Decreasing	0.12	(−1.46, 1.70)	−0.10	(−2.05, 1.84)	1.18	(0.86, 1.63)	1.16	(0.81, 1.67)
Increasing	1.45	(0.51, 2.39)	−1.29	(−2.57, −0.01)	1.00	(0.82, 1.21)	1.16	(0.94, 1.43)
Latino								
Persistent very low	Ref		Ref		Ref		Ref	
Persistent moderately low	2.28	(0.74, 3.81)	−0.40	(−2.26, 1.45)	1.42	(1.07, 1.88)	0.85	(0.65, 1.10)
Persistent medium	2.20	(0.38, 4.02)	−0.96	(−2.59, 0.67)	1.41	(1.02, 1.95)	0.91	(0.67, 1.23)
Persistent high	2.11	(0.31, 3.91)	0.35	(−2.66, 3.36)	1.43	(1.04, 1.97)	0.78	(0.57, 1.05)

[a] Adjusted for sex, age, education, marital status, years of US residence, neighborhood median household income, study site, and exam wave.

[b] From general estimating equation (GEE) linear regression models. Estimates are differences.

[c] From general estimating equation (GEE) logbinomial regression models. Estimates are prevalence ratios.

[d] Exam waves 1 and 5 only. Possible range is 0–100. Healthy Eating Index, reverse coded so that higher scores represent a less healthy diet.

[e] Exam waves 1, 2, 3, and 5 only.

[f] Exam waves 1, 2, and 3 only. Includes leisure time spent “sit[ing] or reclin[ing] and watch[ing] TV,” “read[ing], knit[ting], sew[ing], visit[ing], or do[ing] nothing,” or using the computer; and work time spent expending light effort while sitting.