Neighborhood gentrification, wealth, and co-ethnic density associations with acculturation stressors among Chinese immigrants

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ABSTRACT

Objective: This study examined the cross-sectional relationships between neighborhood social composition and gentrification, and acculturation stressors.

Methods: Person-level data came from first-generation Chinese immigrants enrolled in the Immigrant Enclaves Study (Philadelphia, Pennsylvania, baseline 2018–2020, N = 512). A validated scale was used to assess 22 stressors associated with migration or acculturation. Neighborhood characteristics from the American Community Survey 2015–2019 and 2008–2012 included: tract proportion of foreign born Chinese, neighborhood wealth, and past decade gentrification. Most neighborhood exposures were modeled as continuous as well as binary variables (intended to represent highest level of neighborhood exposure). Multivariable negative binomial regression adjusted for age, gender, income, education, employment, language, years in the U.S., and neighborhood variables (proportion co-ethnic, and neighborhood per capita income).

Results: The majority of participants spoke Mandarin (68% vs Cantonese 32%), mean participant age was 52.7 years old, years in the US was 18, and nearly one-half of the sample had less than 8 years of education. Mean number of stressors was 5.9 with nearly 20% of participants reporting 11 or more stressors. Multivariable results found the number of acculturation stressors was 18% lower for residents in the highest co-ethnic density neighborhoods and 13% lower for residents in the highest wealth areas, compared to other areas (expβ 0.82, 95% CI [CI] 0.69, 0.98; expβ 0.87, CI 0.75, 1.01, respectively). Stressors were no different whether participants lived in gentrified areas or not.

Conclusions: Among middle-aged Chinese immigrants, acculturation stress was lower for residents in neighborhoods with higher proportion of Chinese immigrants and for residents in neighborhoods with higher wealth, whereas gentrification had no influence on acculturation stress. More work on this topic is needed with vulnerable populations such as this one, informed by local context.

1. Introduction

Immigrants to the U.S. can be at significant risk for mental distress. Their risk is most acute if they experience severe language barriers, lack legal authorization to remain in the US, are discriminated against, are unable to secure employment leading to financial stress, lack meaningful social interaction, or are uncertain about where and how to access needed services. These issues can broadly be framed as stressors related to immigration and acculturation stress (Chau, Bowie, & Juon, 2018; Chen, Xu, O'Brien, Gao, & Dong, 2021; Fang, Handorf, Rao, Siu, & Tseng, 2021; Singh, McBride, & Kak, 2015).

As of 2019, approximately 7% of the US foreign born population were of Chinese origin (Census, 2019a; 2019b). Among Chinese immigrants, acculturation stressors have been associated with negative emotional states (Guo & Stensland, 2018), including loneliness (Tseng, Walton, Handorf, & Fang, 2021) and depression (Fang et al., 2021), and

bio-physical manifestations including higher markers of inflammation and insulin resistance (Fang, Ross, Pathak, Godwin, & Tseng, 2014).

There is high interest in how neighborhood residential environments can be favorable or unfavorable to emotional states including stress (Diez Roux & Mair, 2010). Among immigrant populations, co-ethnic density (represented by living in an area with individuals of similar ethnicity) is one of the most frequently studied neighborhood characteristics that could protect immigrants' emotional state (Becares, Dewey, & Das-Munshi, 2018; Osypuk, Diez Roux, Hadley, & Kandula, 2009). Residence in an ethnic enclave have been shown to offer several benefits for Asian immigrant groups, such as increased social and cultural supports and culturally appropriate services (Lim, Yi, Lundy De La Cruz, & Trinh-Shevrin, 2017), even for residents of low-wealth neighborhoods which often have fewer services and less infrastructure (Walton & Hardebeck, 2016). However, there is scant research examining whether residence in co-ethnic enclave affects psychological outcomes among Asian subpopulations and among Asian immigrant subpopulations in particular. Two studies focused on neighborhood density of Asians generally, finding that higher density was associated with better psychological outcomes among women of Chinese descent (although not among men) (Mair et al., 2010) and lower general stress in a sample of female Asian immigrants (Morey et al., 2020). The only study focused on Chinese immigrants that we are aware of reported that higher density of neighborhood residents with Chinese ethnicity protected against psychosocial distress (Tseng et al., 2021). While studies of co-ethnic density and psychosocial outcomes have generally found co-ethnic density to be protective of health, the broader literature on this topic has not been entirely consistent (Denton, Shaffer, Alcantara, Clemow, & Brondolo, 2015; Hong, Zhang, & Walton, 2014; Lim et al., 2017), thus motivating more research in diverse contexts and subpopulations.

There has been recent interest in neighborhood wealth, and changes in neighborhood wealth, on health outcomes. Neighborhood wealth has been linked to reduced negative psychosocial outcomes in Black and white adults (Everson-Rose et al., 2011), possibly due to the ability of higher-wealth neighborhoods to offer more resources to support their residents; yet, few studies have focused on the health effects of socioeconomically ascending neighborhoods. Gentrification refers to a process in which historically lower-income neighborhoods experience a reinvestment of capital and entry of people with higher socio-economic position (Freeman, 2005). Gentrification's effects on increased cost of housing and living expenses may lead to displacement pressure for legacy residents that could be detrimental to stress and social ties. Among existing residents who are able to remain, they may face additional stressors if there is a worsening of neighborhood cohesion or increases in risk of displacement. One of the very few health related studies on this subject reported living in a gentrified and/or upscaled neighborhood was associated with a small increase in the likelihood of serious psychological distress, relative to living in a low-income neighborhood that was not gentrified (Tran et al., 2020). Others have noted that in some communities, gentrification may have beneficial effects if it results in additional or new health-supportive retail/commercial services, transportation services, and/or investment in schools (Schnake-Mahl, Jahn, Subramanian, Waters, & Arcaya, 2020). Some experts note that gentrification may have neutral or positive effects, provided that local policies are in place that protect long-term residents from harassment and spikes in housing cost (Ding, Hwang, & Divringi, 2016; Freeman, 2005). Despite rising gentrification across US urban areas, significant gaps still remain in understanding its effect on resident health and on immigrant health specifically.

Psychosocial outcomes in response to neighborhood wealth and living in socioeconomically ascending neighborhoods have been understudied in Asian-Americans. For example, in the study mentioned above that found an increase in the likelihood of serious psychological distress for those living in gentrified neighborhoods, the study included Asians but did not stratify results by race/ethnicity leaving open the question of whether results were similar for the Asian subgroup (Tran et al., 2020).

In general, there is a high need for more research on neighborhood effects on health and well-being of Asian Americans and importantly, on sub-populations of Asian Americans. Asian Americans represent a heterogeneous group originating from more than 20 countries across Asia and the Indian subcontinent. A focus on specific Asian subpopulations is needed as results may be specific to the origin of the immigrant population (Yi et al., 2022), as well as local context (Spoer et al., 2021). Chinese immigrants' acculturation stress may differ from other Asian immigrants and the effects of neighborhood environments on acculturation stress may differ from other immigrants from Asia for the following reasons. Chinese Americans are the largest subpopulation of Asian Americans in the U.S. (Budiman, López, & Bialik, 2020). In some area of the US the Chinese American community is well-established and able to offer significant social support to new immigrants (Chae & Foley, 2010). Further, Chinese immigrants likely have more language-related stressors than Asians originating from countries where English is widely used as one of the country's official languages (such as in India, Pakistan, Philippines) (2023).

This study used a dataset of Chinese immigrants to examine the cross-sectional relationships between neighborhood characteristics and acculturation stressors. Neighborhood exposures were co-ethnic/immigrant density, neighborhood wealth, and gentrification. The study takes place in Philadelphia, one of the poorest of the top 10 largest cities in the US. We hypothesized that participants residing in areas with higher proportions of co-ethnics and higher neighborhood income would report lower acculturation stress. While there is scant literature to date on Chinese immigrant enclaves, the direction of our hypothesis aligns with most of the findings to date related to Asian immigrants (Mair et al., 2010; Morey et al., 2020; Tseng et al., 2021). We further hypothesized that gentrification would be associated with acculturation stress but did not hypothesize directionality. We did not hypothesize a direction because there is so little literature upon which to draw on and conceptually there are advantageous and disadvantageous consequences.

2. Materials and methods

2.1. Study design & sample

2.1.1. Overview

This cross-sectional analysis uses person-level data collected 2018–2020 from the baseline exam of the longitudinal Immigrant Enclaves Study, which was designed to examine risk of cardio-metabolic conditions among Chinese immigrants residing in/nearby Philadelphia, Pennsylvania. Recruitment for the study occurred via advertising within Chinese community networks, including community centers, medical practices, and word of mouth, described in prior work (Tseng, Wright, & Fang, 2015). Eligibility criteria included: age 35–65 years, Chinese heritage, immigration from Asia during adulthood (age 18+ years), and residence in the Philadelphia area. Approximately two-thirds of the sample was from areas of Philadelphia known to have higher concentrations of persons of Chinese-origin.

Exclusion criteria included: known, diagnosed and/or treated clinical disease (including diabetes, myocardial infarction, stroke, heart failure, cardiovascular procedures, cancers except non-melanoma skin cancer); nursing home residence (current or planned within 2 years); impaired cognitive ability or inability to provide informed consent.

The study was approved by the Fox Chase/Temple IRB (ID#: 18–8001), and all participants provided written informed consent.

2.1.2. Measures

2.1.2.1. Outcome: acculturation stress. Study interviews were conducted

by multilingual staff in English or in one of the two most commonly spoken Chinese dialects, Mandarin or Cantonese. Acculturation stress was measured using the 22-item Migration-Acculturation Stressor Scale (MASS, Supplement Table 1) (Ying, 2005). For each of 22 items, the MASS inquired about migration-related challenges such as homesickness, cultural differences, and social isolation. Respondents were asked to rate the amount of difficulty they encountered in the past year on a scale that ranged from 1 (did not encountered this difficulty) to 5 (encountered the difficulty very much). The MASS has been validated in Chinese samples (Ying, 2005) and correlated with constructs and outcomes as expected (Fang et al., 2021; Fang et al., 2014; Tseng & Fang, 2011; Ying, Han, & Tseng, 2012). It has also shown high internal reliability in the current study sample (standardized α = 0.91) and in the authors' previous samples of Chinese immigrants in Philadelphia (Fang et al., 2021; Tseng & Fang, 2011).

To ensure that the outcome variable used in analyses reflected significant difficulty with a stressor, we only counted a survey item if the participant reported at least "some" difficulty with a stressor (i.e., at least 3 on a Likert scale of 1–5). Difficulty ratings of Likert responses 3 or 4 or 5 were assigned a count value of '1'; counts were then summed to derive each participant's acculturation stress score, with the final score having a potential range of zero to 22. (Note that very few participants reported difficulty levels of 4 or 5 thus, they were collapsed with difficulty level 3.)

2.1.2.2. Neighborhood exposures. Participants resided in 109 census tracts, which were used as a proxy for neighborhood exposure. Residences were geocoded and linked to data from the American Community Survey (ACS) via tract identifiers.

Co-ethnic immigrant neighborhood density (co-ethnic density) was proxied by the proportion of the tract population that was foreign-born Chinese, which included persons originating from mainland China, Hong Kong, and Taiwan. **Neighborhood wealth** was proxied by census tract per capita income (household income adjusted for household size) and represented as dollars in 2019. Both of these measures came from the ACS 5-year estimates 2015–2019.

Gentrification between 2010 and 2010 was derived using the ACS 2008–2012 (to proxy year 2010), and the ACS 2015–2019 (to proxy 2020). The ACS 5-year estimates were used because, small-area (i.e., tract-level) decennial 2010 data and 2020 data were unavailable. Starting in 2005, the Census discontinued their complete socio-demographic and housing survey that they had previously used to derive small-area estimates.

Gentrification is conceptualized as a multi-dimensional measure that identifies neighborhoods that are socioeconomically ascending relative to the city as a whole using median household income, education and housing values to describe this shift. The measure we used was operationalized by Hirsch and Schinasi (2019) (Hirsch & Schinasi, 2019) based on gentrification measures originally developed by Ding et al. (2016) (Ding et al., 2016) and Freeman et al. (2005) (Freeman, 2005) for a select group of metropolitan areas. Measures of gentrification often first establish the threshold that signifies a neighborhood is already too high income and thus not eligible for gentrification ('ineligible to gentrify') (Ding et al., 2016). In order for the measure to reflect local context, the ineligibility threshold was defined relative to values observed for the Philadelphia metropolitan area. Main results in this manuscript classified census tracts as 'ineligible to gentrify' if, during the past decade, the tract was already in the top 10th percentile of Philadelphia metropolitan area median household income. In our Chinese immigrant cohort, very few participants lived in tracts that were deemed high income in the early period (n = 8). Thus, 'ineligible to gentrify' was not retained as a stand-alone category, and participants living in those areas were dropped from analyses. The next step determined which eligible tracts experienced gentrification. Following work by others (Ding et al., 2016; Freeman, 2005), tracts were classified as

gentrified if they had an above-median increase in the proportion of residents with a college education and above median increase in home value or gross rents compared to the Philadelphia region. The rationale that well-known measures have used for focusing on changes in housing values and education are that the former indicate changing affordability and the latter detects increases in groups with higher socioeconomic position, but who may have relatively lower incomes, such as young professionals, artists, etc. (Ding et al., 2016; Freeman, 2005). Following the work of others (Ding et al., 2016; Freeman, 2005), we did not include changes in racial composition in our measure of gentrification in order to separately examine effects on acculturation stress associated with co-ethnic density.

We also explored 2 additional operationalizations, using alternate thresholds for being 'ineligible to gentrify' (see description and sensitivity results in Supplement Table 2). Preliminary analyses showed similar results for all three measures with respect to both the proportion of the sample living in gentrified tracts (approximately 35%) and point estimates for associations between gentrification and acculturation stress; thus, alternate operationalizations will not be discussed further.

2.1.2.3. Supplemental measures of neighborhood change. In order to describe compositional changes during the past decade and provide context to results for gentrification, we constructed two neighborhood change variables: **change in neighborhood wealth** and **change in co-ethnic immigrant density**. In contrast to gentrification which assesses change relative to the metro area, both are absolute differences (ACS 2015–2015 minus 2008–2012) using the variables described above; continuous and binary operationalizations are shown in the Supplement Table 3.

2.1.2.4. Sociodemographic characteristics and covariates. We selected confounders *a priori* based on literature and directed acyclic graphs. Participant characteristics used for adjustment included age, gender, education level, employment, language (used to proxy cultural diversity within the sample), and years lived in the US (derived by subtracting baseline interview year from calendar year-month moved-to-US). Table 2 shows operationalizations used in the analysis. Decisions regarding variable operationalizations were made to aid interpretability and/or to align with the variable distribution in the sample (approximating tertiles and quartiles). Participant household income was proxied by a question asked during the follow-up period approximately 2.6 years after baseline interview, in which participants were asked to select the category best representing their total combined family income for the past 12 months, with these choices: $0 to $26500 (approximately 100% of the federal poverty level for a family of 4 [FPL]), $26501 to $53000 (approximately 200% of the FPL), $53001 to $79500, $79501 to $132500, $132501 to $185000, >$185000 (US-DHHS, 2020).

Because it was only asked during the follow-up period, family income was not answered for all households. Income was the only variable in the main analyses that was missing: 10.4% were missing (54/520). We utilized conditional mean imputation methods to fill-in the values, conditional on fully-observed age, gender, and employment, described below. In the dataset, most participants reported incomes less than $53001; thus, for analytic purposes, the measure was classified into three groups: less than $26501, $26501 to $53000, and more than $53000.

What follows are details on the imputation method. We executed this via SAS PROC MI (Yim, 2015), specifying a monotone logistic regression prediction model, as is appropriate for predicting monotone missingness in a multi-category predictor. We selected the conditional mean imputation method because it is usually less biased compared to listwise deletion and unconditional mean imputation and, when only a single predictor is missing values, it generates results that are very similar to computationally intensive and less tractable stochastic methods (such as multiple imputation). (Paul, Mason, McCaffrey, Fox, & &, 2003; NCES &

Seastrom, 2002).

2.2. Statistical analysis

The analytic sample was 512, representing the baseline sample N = 520 minus 8 who were missing gentrification (see description above). We derived descriptive statistics (means, and cross-classified percentages) for the overall sample and by exposure and outcome. Then, multivariable adjusted negative binomial regression (a generalization of the Poisson distribution suitable for non-negative count data with overdispersion) was used to estimate the number of stressors according to each of the exposure variables. Robust covariance matrix estimation was used to generate robust standard errors that accounted for clustering of participants within census block groups (MacKinnon, Nielsen, & Webb, 2023). (Note that inference was the same when we accounted for clustering of participants within census tracts instead of block groups.)

Models were progressively adjusted first for age and gender; income, education, employment, language, and years in the U.S. were added next; and then other neighborhood level variables added-in. Neighborhood variables were able to serve as adjustment variables because bivariate correlations between neighborhood measures were well below the threshold of 0.7 that can be used to define excessive collinearity (Dormann et al., 2013), Supplement Table 4. Because our progressive adjustment approach produced little change across minimally and fully adjusted models, we only present the fully adjusted models.

Percent of the population foreign born Chinese and neighborhood income were modeled as both continuous and binary variables. The binary variable was constructed using the top tertile, as a proxy for the highest concentration of neighborhood exposure. To aid interpretation of the magnitude of the effect across diverse exposure variables, continuous variables were displayed in standard deviation (SD) units, reflecting approximately one-half standard deviation for each variable. This translated to 2 percentage points for percent of the population foreign-born Chinese and $5000 for neighborhood per capita income. Gentrification was a binary measure indicating the tract gentrified in the past decade or did not gentrify.

Heterogeneity. We tested whether the association between neighborhood variables and acculturation stress was stronger for participants with lower household income <$26,500 (the lowest income category) which was motivated by other work that found lower income persons were more vulnerable to the negative impacts of neighborhood features and gentrification in particular (Smith, Breakstone, Dean, & Thorpe, 2020; Tran et al., 2020). We also examined whether the associations differed for persons who lived at least 10 years in their neighborhood and thus would have experienced changes in the neighborhood over the past decade. When examining heterogeneity, we used the fully-adjusted model, included the product terms between exposure and the modifying variable, and obtained the p-value for the interaction.

3. Results

3.1. Descriptive results

Overall, the mean number of acculturation stressors that participants reported at least 'some' difficulty with was 5.9 (SD = 5.2) out of 22 stressors (or about 25% of the acculturation scale items). About 11% of the sample experienced no stressors and nearly 20% experienced 11 or

Table 1
Neighborhood exposures and sample characteristics, by acculturation score (mean, SD, median), N = 512.

	Value Description	Total		Acculturation stressors		
		N	Col %	Mean	SD	Median (percentile 25th, 75th)
Neighborhood exposures [a]						
Co-ethnic, Chinese immigrant	Lower	356	70%	6.1	5.2	5 (2, 9)
	Highest, top 1/3	156	30%	5.5	5.2	5 (1, 7.5)
Wealth	Lower	340	66%	6.2	5.2	5 (2, 9)
	Highest, top 1/3	172	34%	5.4	5.1	4 (1, 8)
Gentrification, past decade	Not gentrified	327	64%	6	5.3	5 (2, 9)
	Gentrified	185	36%	5.7	5.1	4 (2, 8)
Socio-demographics						
Age, quartiles	≤47	126	25%	6.9	5.9	5 (2, 11)
	48 - <55	144	28%	5.5	4.8	4 (1, 8)
	55 - <60	130	25%	6.2	5.3	5 (2, 9)
	60–66	112	22%	5.1	4.6	4 (2, 7)
Gender	Female	338	66%	6	5.3	5 (2, 9)
	Male	174	34%	5.8	5.1	4 (2, 8)
Language	Cantonese	164	32%	6.4	5.8	5 (1, 10)
	Mandarin	348	68%	5.7	4.9	4.5 (2, 8)
Household income	$0 - <$26,500	240	47%	5.4	4.6	4 (2, 7.5)
	$26,500 - < $53,000	186	36%	6.3	5.1	5 (2, 9)
	≥$53,000	86	17%	6.4	6.7	4 (1, 11)
Employment	Not paid	135	26%	5	4.2	4 (1, 8)
	Paid - service work	195	38%	6.5	5	5 (3, 9)
	Paid - non-office	147	29%	6	5.9	4 (1, 9)
	Paid - professional	35	7%	5.6	6.1	3 (1, 10)
Education	<8 years	240	47%	5.5	4.8	4 (2, 7)
	8–11 years	65	13%	6.8	5.4	5 (3, 10)
	High school equivalent	129	25%	6.2	5.4	5 (2, 9)
	Any post-secondary	78	15%	6	5.6	4 (1, 9)
Years living in the U.S.	<10 years	129	25%	7.1	5.5	5 (3, 11)
	10-<20 years	161	31%	6.1	5.2	5 (2, 9)
	20-<30 years	166	32%	5.3	4.8	4 (1, 7)
	30+ years	56	11%	4.3	4.8	3 (0, 7)
Years living in neighborhood	0-<3 years	105	22%	6.3	5.2	5 (3, 9)
	3-<10 years	211	44%	6	5.5	5 (2, 9)
	10+ years	168	35%	5.5	4.9	4 (1, 8)

[a] Co-ethnic Chinese immigrant category 'lower' refers to 0% - <2.82% and 'highest top 1/3' refers to top tertile 2.82% -< 13.43%. Wealth category 'lower' refers to $8.9 k - <$31.4 k and 'highest top 1/3″ refers to top tertile $31.4 k - $73.6 k.

Table 2

Adjusted cross-sectional estimates of number of acculturation stressors in the past year, according to neighborhood exposures: ethnic density, wealth, and past decade gentrification. N = 512.

Neighborhood Effects	Exp (Beta) [a]	95% Confidence Intervals		P value
		Lower	Upper	
A. Neighborhood co-ethnic density				
Adjusted for age, gender, household income, educational attainment, employment, language, total years in the US, neighborhood wealth, and gentrification.				
i.) Continuous operationalization.				
Percent co-ethnic (continuous), per 2 percentage points [b]	0.95	0.91	0.98	0.003
ii.) Binary operationalization				
Co-ethnic (binary), highest 1/3 vs. less [c]	0.82	0.69	0.98	0.026
B. Neighborhood wealth				
Adjusted for age, gender, household income, educational attainment, employment, language, total years in the US, neighborhood co-ethnic density, and gentrification.				
i.) Continuous operationalization.				
Income per capita (continuous), per $5000 [b]	0.97	0.94	1.00	0.044
ii.) Binary operationalization				
Income per capita (binary), highest 1/3 vs. less [c]	0.87	0.75	1.01	0.070
C. Gentrification, during past decade				
Adjusted for age, gender, household income, educational attainment, employment, language, total years in the US, neighborhood co-ethnic density, and neighborhood wealth.				
Neighborhood gentrified (vs. not)	0.95	0.79	1.14	0.585

CI: confidence interval; Exp(Beta) is the exponentiated beta coefficient to facilitate interpretation.

[a] Negative binomial regression was used to derive these estimates. Beta coefficients represent the difference in the logs of expected number of stressors per unit increase in exposure (or for discrete exposures the exposure category vs. referent category). The exponentiated beta coefficient represents a relative value. Thus, exp (beta) 0.95 can be interpreted as 5% lower number of stressors per 2 percentage points higher neighborhood co-ethnicity.

[b] To aid interpretation, continuous variables are displayed in units that reflect approximately one-half standard deviation in the sample for the variable; units for co-ethnic percent are 2 percentage points, and units for per capita income is $5000.

[c] Co-ethnic binary highest top 1/3 refers to top tertile 2.82% -< 13.43% (vs. less than that). Binary wealth category highest 1/3 refers to top tertile $31.4 k - $73.6 k (vs less than that).

more stressors. When examining which items in the scale had the highest prevalence of reported problems, language was the highest (70%), followed by missing family, friends, and homeland (51%, 55%, 58%, respectively), and cultural differences and discrimination (38% and 36%, respectively, Supplement Table 1).

Table 1 reports demographic and other measured characteristics of the study sample. The majority of the sample was female (66%), and spoke Mandarin (68% vs. Cantonese 32%). At the mean, participants were 52.7 years old (min-max 35 to 66), had lived 18 years in the U.S. and lived in their neighborhood 8.2 years. Nearly one-half of the sample had less than 8 years of education and were below the FPL. Table 1 also shows the prevalence of acculturation stress across covariates. Noteworthy results were that stressors were lower for the oldest age group, those not paid/not employed, and those who lived more years in the US. Acculturation stressors were slightly lower among participants living in neighborhoods with the highest concentrations of co-ethnic residents, and highest neighborhood wealth, and slightly lower in gentrified neighborhoods.

The mean proportion of foreign-born Chinese in the tract population was 2.8% (SD 3.4%, min-max 0–13%). Compared to areas with lower co-ethnic density, areas with the highest co-ethnic density had lower neighborhood wealth and experienced less gentrification but greater past decade increases in co-ethnic population (Supplement Table 3 Distribution of neighborhood characteristics and Supplement Table 4 correlations for neighborhood characteristics).

3.2. Primary adjusted analysis

Table 2 shows that patterns in the bivariate data for co-ethnic density and wealth were largely sustained after adjustment. The number of acculturation stressors was 18% lower for residents in the highest co-ethnic density neighborhoods compared to other areas; it decreased by 5% for every 2 percentage point increase in co-ethnic density (expβ 0.82, 95% CI = 0.69, 0.98, and expβ 0.95, 95% CI = 0.91, 0.98, respectively). The number of acculturation stressors was 13% lower for residents in the highest wealth areas compared to other areas; it decreased by 3% with every $5000 increase in neighborhood per capita income (expβ 0.87, 95% CI 0.75, 1.01, and expβ 0.97 95% CI 0.94, 1.0 respectively).

However, with respect to gentrification, bivariate patterns were not sustained after adjustment. The number of acculturation stressors was not associated with living in gentrified areas compared to those living in non-gentrified areas (expβ 0.95 95% CI 0.79, 1.04).

3.3. Supplemental analysis for neighborhood change

In supplementary analysis for absolute markers of neighborhood change (Supplement Table 5), living in an area with a large increase in past decade neighborhood wealth was associated with 17% lower stressors, compared to other areas (expβ 0.83 95% CI 0.69, 1.00) and the number of acculturation stressors decreased by 6% with every $3000 dollar increase over past decade in neighborhood wealth (expβ 0.94 95% CI 0.90, 0.99). However, adjusted analyses found no evidence that past decade changes in co-ethnic density were associated with acculturation stressors.

3.4. Heterogeneity of effects

There was no evidence of statistical heterogeneity by family income (interaction p > 0.2) or length of residence in neighborhood (interaction p > 0.1) for any of the exposures and acculturation stressors.

4. Discussion

4.1. Summary

In this sample of middle-aged Chinese immigrants, adjusted models

found acculturation stressors were lower for residents in neighborhoods with a higher proportion of Chinese immigrants and for residents in neighborhoods with higher wealth. Past decade gentrification was not associated with acculturation stressors in this sample.

4.2. Discussion of findings

4.2.1. Neighborhood co-ethnic density

Chinese co-ethnic/immigrant density was consistently albeit modestly associated with lower acculturation stressors, decreasing by 5% for every 2% increase in co-ethnic density, with estimates changing little even after adjustment for neighborhood wealth and individual level confounders. This is consistent with three prior studies that reported neighborhood co-ethnic density of Asians as protective of mental health-related outcomes among Asian Americans (Mair et al., 2010; Morey et al., 2020; Tseng et al., 2021). Only one of the prior studies specifically focused on Chinese immigrants (Tseng et al., 2021), finding that higher density of neighborhood residents with Chinese ethnicity protected against loneliness and low social support. The other studies reported results that concurred with our results but only within subgroups of their samples, and those studies assessed co-ethnic density via a general measure of neighborhood concentration of populations of Asian origin (immigrants and non-immigrants). For example, Mair et al. (2010) found neighborhood density of Asians was associated with less depressive symptoms but only among Chinese women (not Chinese men). Another study of Chinese, Filipina, and other Asian women found higher neighborhood Asian concentration was associated with lower general stress but only among the sub-group of recent female immigrants (Morey et al., 2020). One additional study using the National Latino and Asian American Study (NLAAS) reported results that were inverse of what we found: neighborhood co-ethnic density of Asians was associated with worse mental health among Asians (Hong et al., 2014). Divergence from our results may be due to including both foreign-born and US-born Asians, grouping all Asian ethnic subgroups together, as well as the NLAAS sample having much higher socio-economic status than our sample. Future work should explore specific features of areas with high Chinese immigrant density to better understand the mechanism by which co-ethnic density protects against acculturation stressors. We conjecture that protection against stressors may be due to co-ethnic density buffering residents from threats of discrimination and cultural unfamiliarity (Woo, Fan, Tran, & Takeuchi, 2019), in addition to higher density of Chinese-owned businesses and social institutions, which can offer more culturally relevant amenities to Chinese residents (Walton, 2015).

4.2.2. Neighborhood wealth

Our results for neighborhood wealth were also consistent with our hypotheses, providing novel evidence of the positive impact of neighborhood income for acculturation stress in a low-income sample of Chinese immigrants. There are surprisingly few studies that we can use to assess alignment of our results among Asian immigrant communities. Some cross-sectional studies controlled for neighborhood socio-economic status (SES) but did not report direct associations between neighborhood SES and mental health among Asian participants (Mair et al., 2010; Tseng et al., 2021). The exception was a paper using data from the NLAAS where study results diverged from ours, as higher neighborhood SES was associated with more depression and anxiety disorders among Asians. Again, we suspect the divergence may be due to the NLAAS sample having much higher socio-economic status than our sample, and results may be difficult to align as all Asians were grouped together (Alegria, Molina, & Chen, 2014).

4.2.3. Neighborhood gentrification

In our study of lower income Chinese immigrants, acculturation stressors were no different for those who lived in a gentrified area versus neighborhoods that were eligible to gentrify but did not. In contrast, in

our supplementary analyses, we found that past decade increases in neighborhood wealth were associated with lower acculturation stressors. This suggests that absolute levels of neighborhood wealth and increases in neighborhood wealth matter more to acculturation stressors than SES changes relative to the metro area as a whole, as represented by our gentrification classification. Reminder that the gentrification classification was based on changes in tracts that were not already high income in the early period and that experienced a large change in housing values and influx of college-educated residents relative to tracts in the wider metro area. Also possible is that both positive and negative impacts of gentrification were occurring – for example, the availability of new services and resources vs. loss of neighborhood cohesion or risk of displacement (Tseng et al., 2021) – resulting in an overall null effect. Conceptual models have mostly conceived of gentrification (or socio-economically ascending neighborhoods more generally) as potentially negative to health (Schnake-Mahl et al., 2020). The only existing study to date that reported on psychological outcomes among Asians in relation to changes in neighborhood wealth and gentrification was based on data from the Southern California sample of the California Health Interview Survey (Tran et al., 2020). In that study, in the full sample, living in a gentrified and/or upscaled neighborhood was associated with a small *increase* in the likelihood of serious psychological distress, relative to living in a low-income neighborhood that was not gentrified. While the Tran study did not report results stratified by race/ethnicity, some of their findings suggested that results may be different for the Asian/PI subgroup (14% of the sample). Asians/PIs reported overall lower prevalence of serious psychological distress compared to white non-Hispanic persons, and the negative relative association was even stronger for Asians/PIs who lived in gentrified areas. Taken together, the current study and work by Tran and others (Bhavsar, Kumar, & Richman, 2020) suggest that gentrification may not have negative impacts on psychosocial outcomes among Asian communities. However, more studies are needed that directly answer this question and that are done in various contexts and with various Asian-origin subpopulations.

4.3. Strengths and limitations

A major strength of this study was its unique sample of Chinese immigrants. A focus on specific subpopulations of Asian immigrants is needed for understanding key factors contributing to health and well-being across Asian American populations (Yi et al., 2022). Further, very few studies have focused exclusively on new immigrants, in part due to formidable challenges associated with recruitment and follow-up. Participants' immigration status was not asked in our survey, but based on other work (Budiman, López, & Bialik, 2020) we estimate at least one-quarter of the sample was undocumented. Second, Chinese Americans are underrepresented in research, possibly due in part to limited English proficiency (Budiman, 2021). When they are included, research tends to sample predominantly college educated/higher income Chinese Americans (Alegria et al., 2014; Hong et al., 2014) in areas with relatively high concentrations of Asians, such as Los Angeles County or San Francisco, CA, or parts of New York City (Guan et al., 2021; Lim et al., 2017; Morey et al., 2020; Zhang, Metcalf, Palmer, & Northridge, 2022). In contrast, the present study was conducted in Mandarin and Cantonese, and the sample was comprised of lower income residents living in a city where Asians are a distinct minority of the population. Considering the socioeconomic heterogeneity within Chinese Americans as well as the diverse contexts that Chinese immigrants encounter in the US, our study offers a different perspective on the buffering role of co-ethnic density and neighborhood wealth on acculturation stress. The use of a validated instrument to assess acculturation stress is a further strength of the study. Finally, we used a novel measure of gentrification – a multi-dimensional construct to assess change relative to the wider metro area – and contrasted it with past decade absolute change in neighborhood wealth. While there is no consensus on how to define gentrification, the measure we adapted for this study was

conceptualized by well-known experts in the field (Ding et al., 2016; Freeman, 2005).

Despite these strengths, a few limitations remain. The current study did not account for weekly time spent in the neighborhood, nor did we characterize the other neighborhoods where participants spent time (Tam, 2019; Walton, 2017). Additionally, the data used in the current study are cross-sectional; thus, causation cannot be inferred from our results. However, temporal inference is strengthened by the fact that our sample is a new immigrant sample, the questionnaire asked about acculturation stressors which are new stressors post-immigration, and some of our exposures were retrospective measures of change in neighborhood socioeconomic condition.

4.4. Conclusion

This work examines the potential effects of co-ethnic density, neighborhood wealth, and gentrification on acculturation stress in Chinese immigrants in Philadelphia. Findings suggest that acculturation stress experienced by new Chinese immigrants may be mitigated if they are residing near other Chinese immigrants. This may indicate that clustering of immigrant resources, enhancing social connections among immigrants, or preserving culturally appropriate stores and shops may help support immigrant transitions and ease the strain associated with adapting to a new environment. Additionally, our observation that acculturation stressors, while unrelated to gentrification, were lower for Chinese immigrants in areas with neighborhood wealth and in areas that experienced increases in wealth may highlight the importance of infrastructure and economic resources to immigrant well-being. While our results may provide insight for all immigrant groups, they are particularly relevant to Chinese immigrants, one of the fastest growing immigrant groups to the U.S. (Budiman, López, & Bialik, 2020) that also remains highly segregated (Bookings & Frey, 2021; Lee, 2021). More work is needed to define the processes by which neighborhood characteristics and changes within them either positively or negatively impact vulnerable populations within local contexts.

AI and AI-assisted technologies

Generative artificial intelligence (AI) and AI-assisted technologies were not used at any stage of preparing this manuscript (i.e., not used for analyses or during the writing process).

Author statement

Amy H. Auchincloss: data curation, methodology, final analyses, conceptualization, initial draft of manuscript, critical revision; Francesca Mucciaccio: data curation, conceptualization, initial draft of manuscript, critical revision; Carolyn Y. Fang: funding acquisition, conceptualization, methodology, critical revision; Dominic A. Ruggiero: data curation, final analyses, critical revision; Jana A. Hirsch: methodology, critical revision; Julia Zhong: data collection and management, data curation; Minzi Li: data collection and management, data curation; Brian L. Egleston: methodology, critical revision; Marilyn Tseng: funding acquisition, conceptualization, methodology, critical revision.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data used in this manuscript are not publicly available due to human subjects research protections but qualified academic researchers may send data requests to the corresponding author who will pass the request to the study team. If approved, all uses of the data would be subject to confidentiality and data-use agreements.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ssmph.2023.101476.

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