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Neighborhood Social Cohesion and Prevalence of Hypertension and Diabetes in a South Asian Population

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Abstract

South Asians have a high burden of cardiovascular disease compared to other racial/ethnic groups in the United States. Little has been done to evaluate how neighborhood environments may influence cardiovascular risk factors including hypertension and type 2 diabetes in this immigrant population. We evaluated the association of perceived neighborhood social cohesion with hypertension and type 2 diabetes among 906 South Asian adults who participated in the Mediators of Atherosclerosis in South Asians Living in America (MASALA) Study. Multivariable logistic regression adjusted for demographic, socioeconomic, psychosocial, and physiologic covariates. Subgroup analyses examined whether associations differed by gender. South Asian women living in neighborhoods with high social cohesion had 46% reduced odds of having hypertension than those living in neighborhoods with low social cohesion (OR=0.54, 95% CI 0.30–0.99). Future research should determine if leveraging neighborhood social cohesion prevents hypertension in South Asian women.

Keywords

social cohesion; hypertension; type 2 diabetes; South Asians; neighborhood environment

INTRODUCTION

Individuals of South Asian origin, (from India, Pakistan, Bangladesh, Nepal, and Sri Lanka) represent nearly a quarter of the world's population and are one of the fastest growing ethnic groups in the United States [1 2]. The increased risk of cardiovascular disease (CVD) among

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South Asians is well established [3]. In addition, US South Asian immigrants have a considerably higher prevalence of type 2 diabetes (23%) compared to 6% in Caucasians, 18% in African Americans, 17% in Latinos, and 13% in Chinese Americans, and this risk persists after adjusting for socio-demographic characteristics [4]. There is a growing body of evidence on the clinical, behavioral, and genetic factors that influence the development of CVD risk factors among South Asian populations [4–6]. However, there is a paucity of studies examining how neighborhood environment influences U.S. South Asians' high prevalence of CVD risk factors [7].

One important feature of the neighborhood is social cohesion, a concept that captures a key aspect of the neighborhood's social environment. In prior studies, neighborhood social cohesion has been defined by constructs such as perceived connectedness, solidarity, and shared resources that allow people to act together[8]. Social cohesion is hypothesized to affect health by promoting social integration, buffering stress effects, and enforcing social norms and control facilitating positive behavioral changes. Perceived social cohesion has largely been studied in the context of mental health, and numerous studies have shown that social cohesion is protective against depression [9]. More recently, research has also shown that high social cohesion is associated with improved physical health and an overall lower prevalence of chronic illnesses including hypertension, myocardial infarction, and stroke [9–14].

Sex may moderate the effects of social cohesion on health outcomes. Conceptually, neighborhood social cohesion may impact women more than men because women traditionally have spent more time at home than men [15] and women may be more influenced by social-relational contexts than men [16]. One study found that the perceptions about the physical environment were important to men, whereas in women, perceptions about the social quality of the local environment were more important for overall health [17]. Stafford et al. have shown that residential stressors, such as sociopolitical and neighborhood environment (e.g. access to food shops, transportation, and overall quality of neighborhood) had a stronger association with self-rated health for women while economic activity was more strongly related to self-rated health for men [18].

For South Asians, there is evidence that gender roles may influence health, and a recent review showed that men were more likely to make executive decisions about dietary decisions in South Asian households while women often did not engage in physical activity due to competing interests of taking care of the family [19]. However, no studies have looked at the interaction of sex and social environment in this population.

Accordingly, our objective was to determine the association between perceived neighborhood social cohesion and prevalence of both hypertension and type 2 diabetes in U.S. South Asian immigrants. We hypothesized that after adjusting for demographic, socioeconomic, psychosocial, and physiologic risk factors at the individual level, higher neighborhood social cohesion would be associated with lower prevalence of hypertension and type 2 diabetes and that this association would be moderated by sex.

METHODS

Study Population

The Mediators of Atherosclerosis in South Asians Living in America (MASALA) study is a community-based cohort of South Asian adults without known CVD, which was modeled on the Multi-Ethnic study of Atherosclerosis (MESA). Study participants were recruited from two clinical sites – the San Francisco Bay Area through the University of California, San Francisco (UCSF) and the greater Chicago area through Northwestern University (NWU). A total of 906 subjects were recruited between October 2010 and March 2013. Detailed study methods have been previously published [20].

To be eligible for MASALA, participants had to be of South Asian ancestry and have at least three grandparents born in one of the following countries: India, Pakistan, Bangladesh, Nepal, or Sri Lanka, be between the ages of 40–84 years, and be able to speak and/or read English, Hindi or Urdu [20]. Exclusion criteria included a physician diagnosed heart attack, stroke or transient ischemic attack, heart failure, angina, use of nitroglycerin, a history of cardiovascular procedures, current atrial fibrillation, active treatment for cancer, life expectancy < 5 years due to a serious medical illness, impaired cognitive ability, plans to move out of the study region in the next 5 years, living in or being on a waiting list for a nursing home, and weight > 300 lbs [20].

Institutional Review Boards at UCSF and NWU approved of the MASALA Study protocol. The present analysis used de-identified data and was deemed exempt by the Institutional Review Board at the University of Michigan.

Outcome variables

Our primary outcome was a diagnosis of hypertension or type 2 diabetes at the time of baseline data collection. Seated resting blood pressure was measured three times using an automated blood pressure monitor (V100 Vital Signs Monitor; GE Healthcare, Fairfield, CT) with the average of the last 2 readings being used for analysis [20]. Hypertension was defined using the Joint National Committee criteria [21]as a systolic blood pressure (SBP) ≥140 mmHg and/or diastolic blood pressure (DBP) ≥90 mmHg or use of anti-hypertensive medication. Type 2 diabetes mellitus was defined using the American Diabetes Association definition for type 2 diabetes [22]as a fasting plasma glucose ≥126 mg/dL2- hour post-load plasma glucose ≥ 200 mg/dL, or use of anti-hyperglycemic mediations. All blood samples were obtained after a 12-hour fast.

Principal Independent Variable

Our principal independent variable was perceived neighborhood social cohesion, which was measured using a well-validated five-item Likert scale [23 24]. Respondents were asked to report their levels of agreement with the following statements: ‘People around here are willing to help their neighbors,’ ‘People in this neighborhood generally don’t get along with each other,’ ‘People in this neighborhood can be trusted,’ ‘People in this neighborhood do not share the same values,’ and ‘Most people in this neighborhood know each other’[23 24]. For each scale, a score was created by taking the average across all items within the scale

(Cronbach's α=0.65). Scores were then divided into tertiles and defined as low, medium, and high neighborhood social cohesion.

Covariates

We included demographic and socioeconomic variables and observed psychosocial and physiologic risk factors in all multivariable models. Demographic covariates included age, sex, and site of recruitment (UCSF or NWU), and socioeconomic covariates included income, and education. Psychosocial risk factors included chronic burden, depression, social support, and marital status. Chronic burden was measured over the past six months using the Chronic Stress Burden Scale, which is a validated five item scale measuring work and other personal stressors [25]. A higher score reflected greater chronic burden. Depression was measured using the CES-D index where a score of 16 or greater indicates a risk of depression [26]. Social support was measured using the validated Emotional Social Support Index (ESSI, range 6–30) [27]. ESSI was divided into three categories of social support: low (score<12), moderate (score 12–24), and high (score>25) as had been done in prior research on social support and health in later life [28]. The scores were further dichotomized into a low/moderate score <24 and high score of >25 because <2% of the population (n=17) had a low score in our sample.

All participants completed a detailed questionnaire to ascertain socio-demographic information and behaviors (including tobacco and alcohol use) [20]. Physiologic risk factors included were tobacco and alcohol use, obesity, and physical activity. Smoking was defined as currently smoking, and alcohol use was defined as >1drink per week. Central obesity was directly measured as waist circumference in centimeters and used in place of BMI as it has been shown to be more predictive of obesity-related illnesses [29]. Specifically, within South Asians, central obesity has been shown to be highly correlated with insulin resistance after controlling for general obesity[30]. Physical activity was assessed using the Typical Week's Physical Activity Questionnaire [31] categorized into three groups: less than 500 MET/min/wk, 500–1000 MET/min/wk, or greater than 1000MET/min/w based on recommendation of the American College of Sports Medicine and the American Heart Association [32].

Statistical Analysis

Using bivariate and multivariable logistic regressions of 2010–2013 data, we first estimated the associations between higher perceived neighborhood social cohesion and the odds of having hypertension and the odds of having type II type 2 diabetes using Stata 13 software (StataCorp. 2013. *Stata Statistical Software: Release 13*. College Station, TX: StataCorp LP). We analyzed the association with four models: 1) unadjusted; 2) including demographic/socioeconomic covariates; 3) including both demographic/socioeconomic and psychosocial covariates; and 4) including demographic/socioeconomic level covariates, psychosocial covariates, and physiologic covariates.

Interaction analysis was performed to assess if the association between social cohesion and primary outcomes differed by sex. We also stratified the analysis by sex in the fully adjusted model to examine within-group differences in hypertension and type 2 diabetes across the three tertiles of social cohesion. In all estimations, the lowest level of neighborhood social cohesion was used as the reference category. We obtained predicted probabilities using margins of having hypertension and type 2 diabetes at each tertile of neighborhood social cohesion, and present the data as percentage chance of having hypertension or type 2 diabetes [33].

In this analysis, 26 out of 906 (3%) participants had missing information for the variable for income. We addressed the missing data using multiple imputation. Five imputed datasets that assumed a multivariable normal distribution with a Markov chain Monte Carlo approach were created [34 35]. We performed sensitivity analysis using the imputed data to see if there was a significant difference between the analysis with complete observations and the analysis with the imputed data for income.

RESULTS

Detailed socio-demographic characteristics of the MASALA cohort have been published previously [20]. Overall 98% of the study participants were immigrants who had lived in the U.S. for an average of 27±11 years[20]. The mean age of the population was 55 years; 46% were women; 60% had obtained higher than a bachelor's degree in education, and overall the cohort had high socioeconomic status (Table 1). The population as a whole had a low prevalence of smoking and low alcohol use. One-third of the population did not meet recommended exercise goals. Women on average had central obesity, defined as a waist circumference >88cm in women. In comparison, men had a mean waist circumference of 89cm which is lower than the threshold of central obesity in men, defined as >102cm.

Hypertension and type 2 diabetes were significantly associated with high tertile neighborhood social cohesion in unadjusted models with the full sample (Hypertension OR=0.62, 95% CI 0.43–0.91, type 2 diabetes OR=0.57, 95% CI 0.35–0.93) (Table 2). In the adjusted models, there was no statistically significant association between perceived neighborhood social cohesion and diagnosis of hypertension or type 2 diabetes. However, prevalence of hypertension and type 2 diabetes tended to decrease as social cohesion increased. The lowest tertile of social cohesion had a 42% (prevalence of hypertension compared to only 35% (OR=0.70, 0.44–1.09) of participants having hypertension in the highest tertile of social cohesion. Similarly in the lowest tertile of social cohesion, 22% of participants had type 2 diabetes compared to those in the highest cohesion group with 16% (OR=0.68 95% CI 0.40–1.16) prevalence of type 2 diabetes. Sensitivity analysis showed that when imputed incomes were included in the data, the results did not change.

Interaction analysis showed no difference in the association of hypertension and type 2 diabetes with social cohesion between men and women. When stratified for sex, women in the highest tertile of social cohesion had a 27% prevalence (OR=0.54 95% CI 0.30–0.99) of developing hypertension compared to 39% prevalence among women in the lowest tertile of social cohesion (p=0.03). (Table 3). We *a priori* selected waist circumference to meaure central obesity to include in our model, since previous research suggests that it is more predictive of type 2 diabetes risk than BMI in South Asians [30]. However, we did perform an alternative analysis that included BMI with WHO suggested cut-offs for Asian populations[36] (<23=normal, 23–27.5=overweight, and >27.5=obese) which did not alter our reported associations.

DISCUSSION

To the best of our knowledge, this is the first paper to examine how the neighborhood environment influences objectively measured CVD risk factors in US South Asian immigrants, the 2nd fastest growing minority group in the US and one with a very high risk of CVD. In the overall sample, we did not find an association between social cohesion and prevalence of hypertension or type 2 diabetes. In South Asian women, however, higher perceived neighborhood social cohesion was significantly associated with decreased prevalence of hypertension. While there has been a plethora of studies looking at individual-level risk factors for CVD in this population, this is the first study to suggest that neighborhood social environment may exert an effect on South Asian women's health.

In the MESA study, Mujahid et al. found that prior to controlling for race, residents in neighborhoods with more social cohesion were less likely to have hypertension [10]. Another study further found that increased neighborhood social cohesion was associated with better hypertension management [11]. Similarly, there have been studies showing that greater neighborhood resources for physical activity and food are inversely related to insulin resistance and an overall lower incidence of type 2 type 2 diabetes [37 38]. However, no study has examined the link between neighborhood social cohesion and objectively measured type 2 diabetes outcomes. The difference in our results between hypertension and type 2 diabetes may be driven by the pathways through which neighborhood social environments affect health. The neighborhood social environment is hypothesized to affect health by buffering or reducing stress via improving social connections and enforcing norms [9]. Clinically, it may take longer to see the effects of reducing stress on patients with type 2 diabetes outcomes compared to patients with hypertension and this will need to be studied further.

In addition, this study advances the literature by showing that the association of perceived social cohesion with hypertension may be modified by sex. Prior work has found that the effects of neighborhood social environments on health can be moderated by sex [17 18 39]. It has been suggested that women be more responsive to neighborhood environmental influences because they on average have lower levels of labor market participation, and they tend to spend more time in areas close to home because of their heavier involvement in family care as opposed to men who may be spending more time away from the neighborhood working [19 40]. In our sample, 61% of men were currently employed compared to 39% of women. However, we were unable to make inferences about this association due to a lack of power. Future studies will need to study the evolution of this relationship as a larger percentage of women are spending more time in work environments.

Our study had several limitations. First, the MASALA sample is largely comprised of Asian Indian immigrants living in the San Francisco Bay and Chicago areas. These populations may not be representative of all South Asians in the U.S and did on average have a higher level of education and income compared to the general U.S. population. However, it has been shown previously that this population is similar to the U.S. Census 2010 South Asian data [20]. Second, any participants with known cardiovascular disease or symptoms were excluded from the sample, so this sample likely represents an overall underestimation of type 2 diabetes and hypertension prevalence among South Asian Americans. Third, this is a cross-sectional study which limits our ability to make causal inferences. Longitudinal follow-up of the MASALA cohort will allow for further investigations about how these neighborhood effects may vary with time. Fourth, our data did not allow us to adjust for how long participants were living in their respective neighborhoods. Finally, although our study uses a well validated neighborhood social cohesion scale in general U.S. populations, the psychometric properties of this scale have not been evaluated in South Asian populations.

This study adds to the literature by presenting evidence on the association between neighborhood social cohesion and prevalence rates of hypertension and type 2 diabetes in high risk South Asian immigrants. Furthermore, it offers insight into how gender roles may moderate this association. Future research should determine if leveraging neighborhood social cohesion can help prevent hypertension in South Asian women.

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Table 1

Characteristics of the MASALA sample at baseline (2010–2013) (n=906)

	Total	Men	Women
Sample Size	906 (100%	486 (54%)	420 (46%)
Mean age (SD)	55 (9.4)	56 (9.9)	54 (8.6)
Marital Status	829 (92%)	469 (96.5%)	360 (85.7%)
Education			
Below bachelor's degree	110 (12.1%)	48 (9.9%)	62 (14.8%)
Bachelor's degree	261 (28.8%)	123 (25.31%)	138 (32.9%)
Higher than Bachelor's degree	535 (59.1%)	315 (64.8%)	220 (52.4%)
Income[a]			
<=74,999	235 (26.7%)	130 (27.4%)	105 (25.9%)
75,000–199,000	389 (44.2%)	210 (44.3%)	179 (44.1%)
>=200,000	256 (29.1%)	134 (28.3%)	122 (30.1%)
Smoking			
Yes	31(3.4%)	26 (5.4%)	5 (1.2%)
No	875 (96.6%)	460 (94.7%)	415 (98.8%)
Exercise			
<500 MET/min/wk	295 (32.6%)	146 (30.0%)	149 (35.5%)
500–1000 MET/min/wk	180 (19.9%)	97 (20.0%)	83 (19.8%)
>1000 MET/min/wk	431 (47.6%)	243 (50.0%)	188 (44.8%)
Alcohol >1 drink per week			
Yes	299 (33.0%)	220 (45.3%)	79 (18.8%)
No	607(67.0%)	266 (54.7%)	341 (81.2%)
Waist Circumference (SD)			
Men	92.8 (10.32)	96.0 (9.5)	89.1 (10.0)
Women			
Mean CES-D score (SD) (range 0–52)	7.72 (7.1)	7.2 (7.1)	8.3 (7.6)
Chronic Burden in last 6 months			
Score=0	484 (53.4%)	277 (57.0%)	207 (49.3%)
Score=1	261 (28.8%)	129 (26.5%)	132 (31.4%)
Score=2	106 (11.7%)	58 (11.9%)	48 (11.4%)
Score=3–5	55 (6.1%)	22 (4.5%)	33 (7.9%)
Emotional Social Support			
Low/Moderate Social Support (Score 6–24)	364 (40.1%)	186 (38.3%)	178 (42.4%)
High Social Support (25–30)	542 (59.8%)	300 (61.7%)	242 (57.6%

	Total	Men	Women
Employment			
Men	634 (70.0%)	387 (61.0%)	247 (39.0%)
Women			
Site[c]			
NWU	410 (45.3%)	238 (49%)	172 (41%)
UCSF	496 (54.8%)	248 (51%)	248 (59.1%)

[a]Income measured for 880/906 participants

[b]Waist circumference measured in centimeters

[c]NWU=Northwestern University, UCSF= University of California in San Francisco

Table 2

Association of hypertension (OR and predicted prevalence) and perceived neighborhood social cohesion

Model	Covariates	Hypertension		Diabetes	
		OR (CI)	(%)	OR (CI)	(%)
1					
Lowest Tertile	Unadjusted	*Ref*	46%	*Ref*	24%
Medium Tertile		0.77 (0.57–1.04)	40%	0.91(0.64–1.29)	22%
Highest Tertile		0.62 (0.43–0.91)*	35%	0.57(0.35–0.93)*	15%
		p-for-trend:0.01		*p*-for-trend:0.04	
2	Socioeconomic[a]				
Lowest Tertile		*Ref*	43%	*Ref*	22%
Medium Tertile		0.90 (0.75–1.25)	40%	0.99(0.68–1.42)	22%
Highest Tertile		0.69 (0.45–1.06)	35%	0.65(0.39–1.10)	16%
		p-for trend:0.10		*p*-for-trend:0.16	
3	Socioeconomic				
Lowest Tertile	+Psychosocial[b]	*Ref*	42%	*Ref*	22%
Medium Tertile		0.93 (0.66–1.29)	41%	1.02(0.70–1.49)	22%
Highest Tertile		0.71 (0.46–1.10)	35%	0.67(0.39–1.13)	16%
		p-for trend:0.15		*p*-for-trend:0.21	
4					
Lowest Tertile	Socioeconomic	*Ref*	42%	*Ref*	22%
Medium Tertile	+Psychosocial[b]	0.96 (0.68–1.35)	41%	1.06(0.72–1.55)	23%
Highest Tertile	+ Physiologic[c]	0.70 (0.44–1.09)	35%	0.68(0.40–1.16)	16%
		p-for trend:0.14		*p*-for-trend:0.26	

[a]Socioeconomic Factors: age, gender, education, income, site

[b]Psychosocial Factors: depression, chronic burden, social support, marital status

[c]Physiologic Factors: smoking, alcohol, central obesity, physical exercise

*P<0.05 when compared to thereference group

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Table 3

Association of hypertension (OR and predicted prevalence) and perceived neighborhood social cohesion by sex

Neighborhood Social Cohesion[a]	Hypertension				Diabetes			
	Male		**Female**		**Male**		**Female**	
	OR (CI)	**(%)**	**OR (CI)**	**(%)**	**OR (CI)**	**(%)**	**OR (CI)**	**(%)**
Lowest Tertile	*Ref*	45%	*Ref*	39%	*Ref*	28%	*Ref*	14%
Medium Tertile	1.03 (0.63–1.69)	45%	0.92 (0.53–11.57)	37%	0.83(0.50–11.37)	25%	1.53(0.76–13.1)	19%
Highest Tertile	0.91(0.52–11.59)	44%	0.57 (0.31–11.04)*	28%	0.74(0.41–1.33)	23%	0.90(0.40–2.02)	13%
	p-for trend:0.75		*p*-for trend:0.03		*p*-for trend:0.31		*p*-for trend:0.95	

[a] adjusted model included demographics, psychosocial, and physiologic covariates

* $p<0.05$ compared to lowest tertile