Social engagement and chronic disease risk behaviors: The Multi-Ethnic Study of Atherosclerosis

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Abstract:

Objective: Although engagement in social networks is important to health, multiple different dimensions exist. This study identifies which dimensions are associated with chronic disease risk behaviors.

Methods: Cross-sectional data on social support, loneliness, and neighborhood social cohesion from 5381 participants, aged 45–84 from the Multi-Ethnic Study of Atherosclerosis was used.

Results: After adjusting for individual characteristics and all social engagement variables, social support was associated with lower smoking prevalence (PR = 0.88, 95% CI: 0.82, 0.94), higher probability of having quit (PR = 1.03, 95% CI: 1.01, 1.06) and a slightly higher probability of achieving physical activity recommendations (PR = 1.03, 95% CI: 1.01, 1.06). Neighborhood social cohesion was associated with very slightly higher probability of achieving recommended (PR = 1.03, 95% CI: 1.01, 1.05) or any regular (PR = 1.0, 95% CI: 1.01, 1.04) physical activity, and a higher probability of consuming at least five daily fruit and vegetable servings (PR = 1.05, 95% CI: 1.01, 1.09).

Conclusions: Both social support and neighborhood social cohesion, a less commonly considered aspect of social engagement, appear to be important for chronic disease prevention interventions and likely act via separate pathways.

Keywords: Social engagement | Social support | Neighborhood social cohesion | Physical activity | Smoking

Article:

Abbreviations: MESA: Multi-Ethnic Study of Atherosclerosis; MET: Metabolic equivalent.

Introduction

Risk behaviors, including smoking, lack of physical activity and poor diet, contribute to chronic disease, including cardiovascular disease, burden (Mokdad et al., 2004). Social engagement, meaning the degree of an individual's involvement in social networks, may reduce risk behaviors by enhancing self-efficacy, reducing distress and facilitating access to health-related information (Berkman and Krishna, 2014). Social engagement can be conceptualized along multiple dimensions, each capturing a resource gained from social networks (Cohen and Wills, 1985). For example, emotional social support is the love, care and trust in social networks (House, 1981). Another dimension gaining attention is loneliness, representing perceived social and emotional isolation (Hawkley et al., 2005). Finally, neighborhood social cohesion captures solidarity with community networks (Kawachi and Berkman, 2000).

Emotional social support (Delva et al., 2006, Holahan et al., 2011, Poortinga, 2006a, Vaananen et al., 2008) and neighborhood social cohesion (Carpiano, 2007, Kandula et al., 2009, Li et al., 2012) are generally associated with lower, and loneliness with higher (Lauder et al., 2006, Shankar et al., 2011), smoking rates. However, social support (Yun et al., 2010) and social cohesion (Chuang and Chuang, 2008, Li et al., 2012) may be associated with higher smoking rates in groups with high rates of smoking. Emotional social support (Weyers et al., 2010) and neighborhood social cohesion (Cleland et al., 2010, Cradock et al., 2009, Echeverria et al., 2008, Pabayo et al., 2010, Shelton et al., 2011, Utter et al., 2011) are often associated with greater, and loneliness with less (Hawkley et al., 2009, Shankar et al., 2011), physical activity, although associations are inconsistent for social support (Debnam et al., 2012, Poortinga, 2006b) loneliness (Lauder et al., 2006) and social cohesion (Ball et al., 2010, Veitch et al., 2012) in similar large, diverse samples. Emotional social support is also associated with greater fruit and vegetable intake (Debnam et al., 2012, Poortinga, 2006a).

Many studies are limited to one dimension of social engagement, precluding their comparison. Also, these variables should, theoretically, have synergistic interactions, so prior results may underestimate the total potential effect of social engagement on behaviors (Uchino, 2004). There is some evidence of synergistic interactions between social support and loneliness as they relate to health (O'Donovan and Hughes, 2007, Pressman et al., 2005). The presence of countervailing or interacting influences of different types of social engagement may also account for prior conflicting findings. The purpose of this paper was to examine and contrast associations of several related, but distinct, measures of social engagement with behaviors and test for hypothesized synergistic interactions between them.

Methods

Sample

The Multi-Ethnic Study of Atherosclerosis (MESA) is a multi-ethnic cohort study investigating the prevalence and progression of subclinical cardiovascular disease, described elsewhere (Bild et al., 2002). Briefly, 6814 participants aged 45 to 84 without clinical cardiovascular disease

were recruited from six U.S. geographical areas: Baltimore City and Baltimore County, Maryland; Chicago, Illinois; Forsyth County, North Carolina; Los Angeles County, California; New York City, New York; and St. Paul, Minnesota. Each site employed slightly different sampling procedures. However, all sites used random sampling strategies to recruit from available community lists and attempted to recruit equal numbers of men and women from at least two *a priori* categorized racial/ethnic groups (White, Black, Hispanic, and Chinese) to facilitate racial/ethnic comparison of risk factors.

Data collection

Data for these analyses were obtained during the baseline in-clinic examination, which occurred between July 2000 and July 2002, except for loneliness, which was measured in the fourth in-clinic examination, carried out between July 2005 and July 2007. Loneliness is included in the current analyses as there is evidence that loneliness is relatively stable during adulthood (Boomsma et al., 2005). Participants with complete data for analyses of physical activity (n = 5378), fruit and vegetable intake (n = 4966) current smoking status (n = 3408) and smoking cessation among all who ever smoked (n = 2627) were included.

Outcome variables

Three behaviors, each capturing slightly different aspects of chronic disease risk, were dichotomized, using clinically relevant cut points. Smoking status was derived by asking "Have you smoked cigarettes during the last 30 days?" and "Have you smoked at least 100 cigarettes in your lifetime?". To evaluate the progression from never smoking, to smoking, to cessation, current smokers were compared to never smokers, and former smokers were compared to current smokers. Participants who achieved CDC-recommended levels of physical activity (≥ 500 Metabolic equivalent (MET) minutes of moderate to vigorous physical activity weekly) (U.S. Department of Health and Human Services, 2008) were compared to those who reported less. Separately, participants who reported any regular moderate to vigorous physical activity were compared to those who reported none. MET minutes of leisure-time moderate and vigorous physical activity per week were calculated by multiplying the minutes spent in each activity by the MET level for the activity, defined by prior research (Ainsworth et al., 2000), using data from the MESA Typical Week Physical Activity Survey, which was adapted from a previously validated survey (Whitt et al., 2003). The survey asks participants if they performed various activities in a "typical week in the past month", and records the level of effort and amount of time for each activity. Fruit and vegetable intake was calculated as the average daily servings of previously itemized fruit, fruit juice, and vegetable foods (Nettleton et al., 2006) using responses to the MESA 120-item food frequency questionnaire, which is adapted from a previously validated questionnaire (Block et al., 1990) and assesses typical diet over the past year. In analyses, five daily servings of fruits and vegetables was used as a cut point, which is roughly equivalent to the minimal suggested intake (U.S. Department of Agriculture and U.S. Department of Health and Human Services, 2010), but since most participants did not meet this recommendation, a separate model also compared those who consumed at least two daily servings to those who consumed less than two, comparable to prior work (Poortinga, 2006a).

Main independent variables

Social support was measured using the six-item emotional social support index (Mitchell et al., 2003), which asks about having someone available to listen, or provide advice, or show affection (Cronbach's α in this sample = 0.88). Loneliness was measured with an instrument derived from the revised University of California at Los Angeles Loneliness Scale (Russell et al., 1980) (α = 0.79), asking participants how often they lack companionship, feel left out, or isolated from others. Neighborhood social cohesion was assessed with the instrument from the Project on Human Development in Chicago Neighborhoods (Sampson et al., 1997), asking participants if the neighborhood is close-knit and whether neighbors help each other, get along, can be trusted, and share the same values (α = 0.70). Because hypotheses focused on how individual-level perceptions of social engagement influence health behaviors, perceived neighborhood social cohesion was examined as an individual-level variable. Scores from each instrument were standardized (i.e. z scores) prior to analyses.

Covariates

Demographic characteristics, socioeconomic factors and self-reported health were considered potential confounders and adjusted for in analyses. This included age, sex, marital status (married, widowed, divorced/separated, never married), race/ethnicity (White, Black, Hispanic, Chinese), family annual income (<$16,000, $16,000–$29,999, $30,000–$49,999, $50,000–$74,999, >$75,000),level of education achieved (< high school, high school/GED, some college/technical school/Associate's degree, Bachelor's degree, Graduate degree) and study site (categorized as above). Self-reported health (poor/fair, good, very good, excellent) was also included since health declines may lead to both social isolation and behavior changes.

Statistical analysis

Prevalence ratios (PR) of behaviors associated with standardized social engagement variables (i.e. z scores) were modeled with Poisson regression, using robust standard errors (Wacholder, 1986, Zou, 2004) in Stata 10 (StataCorp, 2007). Models were built in a step-wise fashion, testing unadjusted associations, then adjusting for covariates prior to adding all social engagement variables. Interaction terms between each pair of social engagement variables were then tested and retained in the model if they were both statistically significant ($p < 0.05$) and improved model fit, based on Akaike Information Criterion (Akaike, 1974). Stratified analyses were used to further examine statistically significant ($p < 0.05$) interactions. Correlations between social engagement variables were also examined.

Results

Table 1 describes characteristics of the sample, comparing individuals with low and high levels of each social engagement variable, split at the median value. Overall, socially engaged participants tended to be slightly older, male, White, married, and have higher incomes and better health. There was also no evidence of collinearity in adjusted analyses (i.e. variance inflation factor ≥ 10, tolerance ≤ 0.1). Also, loneliness, which was measured at the fourth examination, was correlated with social support, measured at both the first and the fourth examination (Spearman $\rho = -0.3879$ and -0.5106, respectively). Linear associations between

the logarithmic prevalence ratio and standardized social integration variables were confirmed using lowess plots, which is a nonparametric method used to visualize the relationship between variables (Cleveland and Mcgill, 1985).

Table 1. Characteristics of participants and subgroup mean values of social engagement variables, Multi-Ethnic Study of Atherosclerosis (MESA) (n = 5381).

	Sample characteristics	**Mean social support (SD)[a]**	**Mean loneliness (SD)[a]**	**Mean neighborhood social cohesion (SD)[a]**
Overall sample mean (SD)		**24.24 (5.22)**	**4.00 (1.41)**	**17.57 (2.88)**
Scale range		**6–30**	**3–9**	**5–25**
Mean age (SD)	61.35 (9.96)			
Age categories (%)				
45–54	1648 (30.6)	**23.88 (5.25)**	**4.19 (1.53)**	**17.42 (2.82)**
55–64	1547 (28.8)	**24.22 (5.27)**	**3.96 (1.36)**	**17.59 (2.92)**
65–74	1576 (29.3)	**24.53 (5.12)**	**3.88 (1.35)**	**17.70 (2.86)**
75–84	610 (11.3)	**24.52 (5.20)**	**3.87 (1.33)**	**17.56 (2.95)**
Sex (%)				
Female	2844 (52.8)	**23.84 (5.19)**	**4.12 (1.47)**	17.55 (2.90)
Male	2537 (47.2)	**24.69 (5.21)**	**3.86 (1.33)**	17.59 (2.86)
Race/ethnicity (%)				
White	2193 (40.8)	24.26 (5.14)	**3.97 (1.40)**	**17.97 (2.79)**
Chinese	648 (12.0)	23.74 (5.06)	**3.80 (1.25)**	**17.11 (2.42)**
Black	1370 (25.5)	24.43 (5.06)	**3.99 (1.37)**	**17.70 (3.01)**
Hispanic	1170 (21.7)	24.26 (5.60)	**4.16 (1.56)**	**16.91 (2.97)**
Education (%)				
< High school	835 (15.5)	24.18 (5.78)	4.13 (1.54)	**16.94 (3.01)**
High school/GED	955 (17.8)	24.33 (5.09)	3.99 (1.42)	**17.46 (2.90)**
Some college	1540 (28.6)	24.14 (5.20)	3.96 (1.39)	**17.52 (2.87)**
Bachelor's	994 (18.5)	24.16 (5.09)	3.97 (1.39)	**17.81 (2.84)**
Graduate school	1057 (19.6)	24.42 (5.01)	3.98 (1.36)	**18.00 (2.71)**
Income (%)				
< $16,000	883 (16.4)	**23.09 (5.83)**	**4.25 (1.63)**	**16.86 (2.95)**
$16,000–$29,999	952 (17.7)	**23.49 (5.46)**	**4.12 (1.44)**	**17.17 (2.80)**
$30,000–$49,999	1266 (23.5)	**23.91 (5.34)**	**4.00 (1.40)**	**17.53 (2.95)**
$50,000–$74,999	944 (17.5)	**24.71 (4.79)**	**3.91 (1.33)**	**17.85 (2.82)**
>$75,000	1336 (24.8)	**25.52 (4.43)**	**3.80 (1.26)**	**18.15 (2.71)**
Marital status (%)				
Married	3394 (63.1)	**25.36 (4.59)**	**3.80 (1.27)**	**17.74 (2.82)**
Widowed	630 (11.7)	**23.27 (5.54)**	**4.18 (1.53)**	**17.54 (3.03)**
Divorced/separated	908 (16.9)	**22.06 (5.54)**	**4.39 (1.59)**	**17.14 (2.94)**
Never married	449 (8.3)	**21.55 (5.87)**	**4.45 (1.60)**	**17.14 (2.84)**
Physical health (%)				
Poor/fair	442 (8.2)	**23.31 (5.46)**	**4.51 (1.58)**	**16.48 (3.15)**
Good	2155 (40.1)	**24.11 (5.31)**	**4.04 (1.46)**	**17.33 (2.86)**
Very good	1867 (34.7)	**24.23 (5.13)**	**3.92 (1.35)**	**17.87 (2.71)**
Excellent	917 (17.0)	**25.02 (4.96)**	**3.80 (1.28)**	**18.04 (2.92)**

Bold print identifies statistically significant subgroup differences based on ANOVA.

[a] Values represent scores for social engagement variables prior to standardization.

Unadjusted and adjusted prevalence ratios of risk behaviors in relation to a standard deviation increase of social engagement variables are shown in Table 2. In unadjusted models (Model 1), each standard deviation increase in either social support or neighborhood social cohesion was associated with a lower prevalence of smoking, and an increase in loneliness was associated with higher prevalence of smoking. After adjusting for other individual characteristics (Model 2), only associations with social support and loneliness remained statistically significant. After further adjustment for social support, loneliness and neighborhood social cohesion (Model 2), only the relationship with social support remained statistically significant.

Table 2. Prevalence ratios of selected behaviors associated with a standard deviation increase in social engagement variables, Multi-Ethnic Study of Atherosclerosis, 2000–2002.

	Model 1[a] PR (95% CI)	**Model 2[b] PR (95% CI)**	**Model 3[c] PR (95% CI)**
Current smoking status (n = 3408)			
Social support	0.83 (0.78, 0.88)	0.87 (0.81, 0.92)	0.88 (0.82, 0.94)
Loneliness	1.15 (1.09, 1.22)	1.08 (1.02, 1.14)	1.03 (0.97, 1.10)
Neighborhood social cohesion	0.92 (0.85, 0.98)	0.97 (0.90, 1.03)	0.99 (0.93, 1.06)
Former smoking (n = 2627)			
Social support	1.07 (1.04, 1.09)	1.05 (1.02, 1.07)	1.03 (1.01, 1.06)
Loneliness	0.93 (0.91, 0.96)	0.96 (0.94, 0.99)	0.98 (0.95, 1.00)
Neighborhood social cohesion	1.03 (1.01, 1.05)	1.02 (1.00, 1.04)	1.01 (0.99, 1.03)
Recommended level of physical activity (n = 5378)			
Social support	1.05 (1.03, 1.08)	1.05 (1.02, 1.07)	1.03 (1.01, 1.06)
Loneliness	0.95 (0.93, 0.97)	0.96 (0.94, 0.98)	0.97 (0.95, 1.00)
Neighborhood social cohesion	1.05 (1.03, 1.07)	1.03 (1.01, 1.06)	1.03 (1.01, 1.05)
Any regular physical activity (n = 5378)			
Social support	1.03 (1.01, 1.05)	1.03 (1.01, 1.05)	1.02 (1.00, 1.04)
Loneliness	0.97 (0.96, 0.99)	0.98 (0.97, 1.00)	0.99 (0.97, 1.01)
Neighborhood social cohesion	1.04 (1.03, 1.06)	1.03 (1.01, 1.04)	1.02 (1.01, 1.04)
≥ 5 daily fruit and vegetable servings (n = 4966)			
Social support	1.02 (0.98, 1.06)	1.02 (0.98, 1.06)	1.01 (0.97, 1.06)
Loneliness	0.99 (0.96, 1.03)	0.99 (0.96, 1.03)	1.00 (0.96, 1.05)
Neighborhood social cohesion	1.05 (1.01, 1.09)	1.05 (1.01, 1.09)	1.05 (1.01, 1.09)
≥ 2 daily fruit and vegetable servings (n = 4966)			
Social support	1.01 (1.00, 1.02)	1.01 (1.00, 1.02)	1.01 (1.00, 1.02)
Loneliness	0.99 (0.98, 1.01)	1.00 (0.99, 1.01)	1.00 (0.99, 1.02)
Neighborhood social cohesion	1.01 (1.00, 1.02)	1.01 (1.00, 1.02)	1.01 (1.00, 1.02)

[a] Unadjusted associations for each standard deviation increase in social engagement variable. Social support SD = 5.17 on scale ranging from 6 to 30. Loneliness SD = 1.40 on scale ranging from 3 to 9. Neighborhood social cohesion SD = 2.86 on scale ranging from 5 to 25.

[b] Adjusted for age, sex, race/ethnicity, income, education, and study site, marital status, and physical health.

[c] Model added standardized scores for social support, loneliness and neighborhood social cohesion.

In unadjusted models (Table 2, Model 1), higher social support and neighborhood social cohesion were both associated with a higher probability, and loneliness with a lower probability, of having quit among all participants who had ever smoked. After accounting for other

individual characteristics (Model 2), only social support and loneliness remained associated with having quit and after accounting for all social engagement variables (Model 3), only social support was associated with having quit.

In unadjusted analyses, (Table 2, Model 1) higher social support and neighborhood social cohesion were associated with slightly higher probability, and loneliness with slightly lower probability, of achieving the recommended level of physical activity. These associations remained after adjusting for individual characteristics (Model 2), but after accounting for all social engagement variables (Model 3), only social support and neighborhood social cohesion remained statistically significant. A similar pattern of results was obtained when examining the probability of engaging in any regular physical activity, except that neighborhood social cohesion alone was statistically significant in the fully adjusted model (Model 3).

In unadjusted analyses, (Table 2, Model 1) neighborhood social cohesion was associated with a slightly higher probability of consuming at least five daily fruit and vegetable servings, and this association remained after adjusting for individual characteristics and other social engagement variables (Model 3). None of the social engagement variables was associated with the probability of consuming at least two daily fruit and vegetable servings.

Finally, this study tested interactions between dimensions of social engagement. There was evidence for interaction between social support and loneliness in the case of current smoking (p for interaction = 0.028). In the fully adjusted model, the association of social support with current smoking was stronger in persons reporting no degree of loneliness (n = 1823) than in those who reported some loneliness (n = 1585): (PR = 0.82, 95% CI: 0.74, 0.92 and PR = 0.91, 95% CI: 0.84, 0.99 respectively). However, no other interactions were found between social engagement variables for risk behavior outcomes.

Discussion

This study is among the first to compare several dimensions of social engagement in relation to chronic disease risk behaviors and consider interactions among them. After adjustment for all three dimensions of social engagement, both social support and neighborhood social cohesion, a less commonly considered variable, were relevant to chronic disease risk behaviors. Social support was more strongly related to smoking prevalence in non-lonely individuals, but no other evidence was found for hypothesized synergistic interactions.

Although social support is a frequent focus of health researchers, few studies have compared its predictive utility relative to other measures of social engagement. This study adds to the literature by suggesting that while only social support is associated with smoking behaviors, both social support and neighborhood social cohesion are independently associated with physical activity and neighborhood social cohesion is relevant for dietary behaviors. In another Chicago study of middle aged and older adults, loneliness, and not social support, was associated with physical activity (Hawkley et al., 2009). Together, these results suggest that social support is important for smoking, but other aspects of social engagement should be considered for physical activity and diet.

There are several potential reasons for these results. For smoking, although there was no evidence of collinearity between loneliness and social support, the moderate correlation between social support and loneliness, combined with relatively weak associations, may have limited precision when estimating the independent associations of both variables. It is also possible that social support and loneliness act via separate intersecting pathways, as has been theorized elsewhere (Uchino, 2004), since the present study found interactions in their relationships with smoking behaviors.

Although these results suggest that social support is related to smoking behaviors, the evidence for physical activity and fruit and vegetable intake is not as strong in this study and others, reviewed earlier. Although these results do not fully elucidate prior inconsistent results for neighborhood cohesion and physical activity found even in longitudinal data (Cradock et al., 2009, Pabayo et al., 2010, Veitch et al., 2012), they add to the literature by hinting that perceived neighborhood cohesion may be more relevant than either social support or loneliness to physical activity, though the underlying association may be relatively weak. Also, the present study, among the first to examine associations between social engagement and fruit and vegetable intake, suggests that neighborhood social cohesion is associated with only a slightly higher likelihood of consuming the recommended intake of fruits and vegetables.

Lack of robust associations between social engagement and physical activity and diet may occur because numerous other factors, such as time, finances, cultural and normative factors, personal preferences and the physical environment, constrain physical activity and diet. Alternatively, we characterized neighborhood cohesion using individual perceptions because we hypothesized that perceptions influence behaviors. There may be other processes through which actual neighborhood-level cohesion (characterized as neighborhood aggregated measures) affect behaviors, such as communication of social norms (Ahern et al., 2009) or associations of cohesion with physical environment features (Cohen et al., 2008). Weak associations may also be due, in part, to the use of dichotomous outcomes. However, dichotomous outcomes ensure that the findings are clinically relevant by anchoring outcomes to recommended behavioral thresholds.

Finally, this study found very little evidence of hypothesized synergistic interactions between social engagement variables. Consistent with other studies (O'Donovan and Hughes, 2007, Pressman et al., 2005), social support and loneliness interacted. Perhaps either social support buffers loneliness-induced stress (Cohen and Wills, 1985, Hawkley and Cacioppo, 2003), or lonely individuals are less able to access social support in their networks (Uchino, 2004). Failure to find other interactions may be due to weaker associations for physical activity and fruit and vegetable intake. Alternatively, results may reflect truly independent pathways between various dimensions of social engagement and risk behaviors. For example, social cohesion may influence behaviors by enforcing social norms for behaviors or increasing tangible support for particular behaviors (McNeill et al., 2006), and this may not be affected by social support or loneliness.

Regardless of the reasons for these results, they suggest that behavioral interventions and other chronic disease prevention strategies might do well to consider both social support and neighborhood social cohesion. Behavior change researchers have called for more behavioral

interventions that target social contexts, which are thought to be superior to those that simply target individuals because they address the setting in which behaviors are performed (Emmons, 2000). Few interventions have actually targeted social variables, other than the well-known Enhancing Recovery in Coronary Heart Disease trial (ENRICHD Investigators, 2000). Alternatively, health communication may be tailored to an individual's social engagement (Kreuter and Wray, 2003), so that specific content in health messages varies according to an individual's level of social support, for example. Despite the idea that such tailoring will improve the relevance of interventions, and some evidence of increased effectiveness (Noar et al., 2007), very few socially tailored interventions have been tested. Results from this study add to the literature by suggesting that such interventions consider not only social support, but also neighborhood social cohesion.

It should be noted that associations between social engagement and behaviors represent just one pathway leading from social engagement to chronic disease. Psychosocial pathways, such as stress and depression, and physiologic pathways, including allostatic load and inflammatory burden, have also been hypothesized (Berkman and Krishna, 2014). Thus, the total association between social engagement and chronic disease is likely greater than the associations found in this study and further work is needed to elucidate those pathways.

Study limitations and strengths

Cross-sectional data prevent evaluating temporality and are amenable to selection/survival bias. Also, self-report may induce bias for physical activity (Prince et al., 2008), although self-reported smoking is generally valid (Patrick et al., 1994), and the food frequency questionnaire in this study demonstrated criterion validity for carbohydrate and fat intake by comparison with plasma lipids (Nettleton et al., 2009). Reliance on self-reported data for both the predictor and outcome may also have inflated estimates, due to same source bias. Due to the large sample, these limitations may have biased the results, resulting in statistically significant findings despite lack of true associations and statistically significant interaction terms may have been found by chance, due to the multiple comparisons tested. This study conceptualized social engagement as universally beneficial. However, engagement may also consist of negative aspects, including conflict, demands, and social role strain (Berkman and Krishna, 2014). Greater attention should be given in future work to the potential countervailing adverse effects of social engagement. Also, other social factors, such as social norms or social influence, were not measured in this study, but may influence associations found (Berkman and Krishna, 2014). This study is strengthened by addressing theoretically-driven hypotheses. Also, this study is strengthened by use of a large multi-ethnic sample, the use of several distinctly different measures of social engagement, and clinically relevant outcomes.

Conclusions

In conclusion, our study found that social support was associated with smoking prevalence and smoking cessation and was more strongly associated with lower prevalence of smoking among non-lonely individuals, suggesting an interacting pathway between these two types of social engagement. However, neighborhood social cohesion, a less commonly studied dimension

of social engagement, may be more relevant for physical activity and diet and may act via separate pathways.

Conflict of interest statement
The authors declare that there are no conflicts of interest.

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