

# Effect of Network Social Capital on the Chances of Smoking Relapse: A Two-Year Follow-up Study of Urban-Dwelling Adults

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Tobacco smoking is a risk factor for a range of ill health conditions, including lung cancer, stroke, heart disease, and chronic respiratory disease.<sup>1</sup> In 2010, worldwide tobacco smoking, including secondhand smoking, was ranked as the second highest risk factor contributing to the overall global burden of disease with estimates placing global smoking prevalence at 23.7%.<sup>1,2</sup> Researchers have suggested that cessation by current smokers offers the only practical way to avoid a substantial proportion of global tobacco-related deaths in the coming decades.<sup>3</sup> Relapse is common during smoking cessation attempts.<sup>4,5</sup> Social support interventions, which involve a person's close social relationships, have been shown to be important in preventing relapse.<sup>5</sup> Developing effective network interventions to reduce smoking requires a greater understanding of the range of social network influences beyond social support that might be leveraged to encourage cessation and prevent relapse.

Research on social influences and smoking have highlighted the importance of social networks on a range of smoking behaviors, including initiation, cessation, and relapse.<sup>6-8</sup> Network influences on smoking might operate in a positive or negative fashion: being connected to others who smoke might lead to an increased risk of smoking, whereas being connected to people who do not smoke might reduce the risk.<sup>9</sup> Although much research has focused on youth smoking, studies have also shown the importance of social networks and support for adult smoking.<sup>10,11</sup> For example, using data from the Framingham Heart Study, Christakis and Fowler reported that smoking cessation clustered among more connected groups of people, suggesting the diffusion of cessation behavior within social networks.<sup>7</sup> Research has also shown the importance of social support in smoking cessation and relapse.<sup>10,12</sup> For example, Holahan et al. showed

**Objectives.** We sought to examine the prospective influence of social capital and social network ties on smoking relapse among adults.

**Methods.** In 2010, a 2-year follow-up study was conducted with the 2008 Montreal Neighborhood Networks and Healthy Aging Study (MoNNET-HA) participants. We asked participants in 2008 and 2010 whether they had smoked in the past 30 days. Position and name generators were used to collect data on social capital and social connections. We used multilevel logistic analysis adjusting for demographic and socioeconomic factors to predict smoking relapse in 2010.

**Results.** Of the 1400 MoNNET-HA follow-up participants, 1087 were nonsmokers in 2008. Among nonsmokers, 42 were smokers in 2010. Results revealed that participants with higher network social capital were less likely (odds ratio [OR] = 0.68; 95% confidence interval [CI] = 0.47, 0.96), whereas socially isolated participants (OR = 3.69; 95% CI = 1.36, 10.01) or those who had ties to smokers within the household (OR = 4.22; 95% CI = 1.52, 11.73) were more likely to report smoking in 2010.

**Conclusions.** Social network capital reduced the chances of smoking relapse. Smoking cessation programs might aim to increase network diversity so as to prevent relapse. (*Am J Public Health.* 2014;104:e72-e76. doi:10.2105/AJPH.2014.302239)

that general social support reduced the chances of smoking relapse among adult women.<sup>10</sup> Social support resources might emerge from formal (e.g., clinics or support groups) or informal sources; when informal, support for smoking cessation tends to come from a person's close friends or family members (e.g., spouse or partner).<sup>13</sup> Although the importance of support and close ties in smoking behaviors is thus recognized, less is known about the influence of network social capital on smoking.

In this study, we examined 3 social network influences on smoking relapse: social capital, social isolation, and having strong ties to other smokers (i.e., smoking alters). First, social capital refers to the resources to which individuals and possibly groups have access through their social networks. In contrast to social support, which tends to emerge from a person's strong, core social connections, social capital often emerges from a person's weaker and more heterogeneous social connections.<sup>14,15</sup> Most

studies on social capital and smoking have applied proxy measures of social capital such as generalized trust and social participation to examine its link to smoking behavior. These studies have shown that those persons with higher levels of social participation or generalized trust are less likely to smoke<sup>16,17</sup> and more likely to cease smoking.<sup>11</sup> Few studies have examined network social capital and smoking prospectively, and, therefore, less is known about the potential influence of network capital on smoking behavior. Second, social isolation (i.e., not having social connections) can also impact smoking behavior.<sup>18</sup> Choi and Smith, for example, showed that social isolation can lead to smoking as a means of managing negative moods that might emerge from the lack of social connections and support.<sup>19</sup> Finally, being socially isolated might increase smoking risk but having social connections can also increase risk, if those connections tend to be to smokers. Strong ties to smokers might lead to smoking

initiation or relapse through various mechanisms, including normative or social learning mechanisms.<sup>20</sup> For example, Homish and Leonard showed that spouses actually exercised a stronger influence on a partner's chances of relapse than cessation.<sup>21</sup> Living with smokers regardless of relationship status has also been shown associated with smoking.<sup>22</sup> Despite such findings, little is known on whether the influence of having strong ties to smokers on adult smoking relapse is similar across different spatial units (e.g., sharing a household compared with residing in the same neighborhood).

In this study, we examined the importance of 3 social network influences on smoking relapse and whether there are protective effects of network social capital on relapse. Based on previous research, we expected network social capital, social isolation, and having strong ties to smokers to have independent and different relationships to smoking relapse. Four hypotheses on the relationship between adult social network characteristics and smoking relapse guided the study: (1) the higher a person's network social capital, the lower that person's chances of smoking relapse; (2) adults who are socially isolated have increased chances of smoking relapse; (3) the greater the number of strong ties to smokers that a person has, the greater their chances of smoking relapse; and (4) the more spatially proximate smoking alters are to participants, the more likely they are to relapse. To test these hypotheses, we examined prospectively the influence of baseline levels of network social capital and social network characteristics on adult smoking behavior 2 years later.

## METHODS

Data came from the 2008 Montreal Neighborhood Networks and Healthy Aging Study (MoNNET-HA) and the 2-year follow-up study in 2010. At baseline, the MoNNET-HA study used a 2-stage stratified cluster sampling design. In stage 1, Montreal Metropolitan Area census tracts ( $n = 862$ ) were stratified using 2001 Canada Census data into tertiles of high, medium, and low household income. We selected 100 census tracts from each tertile ( $n_j = 300$ ). In stage 2, we stratified potential

respondents within each tract into 3 age groups: 25 to 44 years, 45 to 64 years, and 65 years or older. Three respondents were randomly selected within each age stratum and census tract for a total of 9 respondents per tract, except for 7 tracts in which 4 participants were selected ( $n_j = 2707$ ). To be selected, individuals had to (1) be noninstitutionalized, (2) have resided at their current address for at least 1 year, and (3) be able to complete the questionnaire in French or English. We used random digit dialing of listed telephone numbers to select households and a computer-assisted telephone interviewing system guided questionnaire administration. Participants completed the initial telephone interview between June and early August 2008. The wave 1 MoNNET-HA response rate was 38.7%. The  $\chi^2$  analysis comparing the sample to a range of 2006 Canada census variables showed that the wave 1 MoNNET-HA sample overrepresented women, households with an income less than CAN\$50 000 per year, persons who lived in their current residence for more than 5 years, or those with more than a high school degree.

We sought out MoNNET-HA participants who agreed to be re-contacted ( $n = 2256$ ) for follow-up telephone interviews in 2010. A total of 1400 MoNNET-HA respondents participated in the follow-up study for a participation rate of 62.1%. Analyses showed that wave 2 MoNNET-HA participants were more likely to be Francophone, educated, younger than 65 years, or Canadian-born compared with the 2008 sample. To examine smoking relapse, we created a sub-sample of wave 2 MoNNET participants by excluding those who reported smoking in 2008.

## Measures

**Smoking relapse.** To assess smoking status, we asked participants in 2008 and 2010 whether they had smoked (tobacco products) in the past 30 days. Using the sub-sample of wave 2 MoNNET participants, we defined smoking relapse as those who did not smoke in 2008 but reported smoking in 2010.

**Network social capital.** The MoNNET-HA position generator assessed social capital by asking participants whether they knew someone on a first name basis working in a range of 10 occupations.<sup>7</sup> These occupations were

assigned prestige values.<sup>12</sup> Social capital was measured along 3 dimensions: (1) reachability (i.e., the highest prestige occupation that a person accessed), (2) diversity (i.e., the number of different occupations accessed), and (3) range (i.e., the difference between the highest and lowest prestige occupation accessed).<sup>23</sup> Given high correlation among dimensions, principal components analysis was used to create a social capital score, with range contributing the greatest value (0.69). Further information about the MoNNET position generator can be found elsewhere.<sup>15</sup>

**Social isolation.** The MoNNET-HA name generator asked participants to name up to 3 people (i.e., alters) with whom they discussed important matters in the past 6 months. Those nominated were identified as participants' core ties. If participants answered nobody, interviewers confirmed whether participants did not wish to answer the question or had not spoken with anyone about important matters. Following previous research,<sup>15,24</sup> we defined social isolation as those participants who reported that they had not spoken with anyone about important matters in the past 6 months.

**Smoking alters.** Following the name generator question, we asked participants whether their nominated core ties smoked or not and if their core ties resided in their household, neighborhood, Montreal, or outside Montreal. The total number of smoking alters and the number per location was then calculated. Values could range from 0 to 3.

**Confounders.** Sociodemographic factors included gender, age, and primary household language. Participants identified their gender. We grouped participants' ages into 6 categories: (1) 25 to 34 years, (2) 35 to 44 years, (3) 45 to 54 years, (4) 55 to 64 years, (5) 65 to 74 years, and (6) 75 years or older, with the youngest age group used as the reference. Respondents identified the primary household language as French, English, or other, with French used as the referent. Participants selected their household income from 5 categories: (1) less than CAN\$28 000, (2) CAN\$28 000–CAN\$49 999, (3) CAN\$50 000–CAN\$74 999, (4) CAN\$75 000–CAN\$100 000, and (5) more than CAN\$100 000. Income was imputed for 16.5% of the wave 2 respondents using ordinal regression and participant data (1) on socio-demographic variables, including education,

age, and employment status and (2) Canada census data on median household income for the census tract in which they resided. To assess educational attainment, participants were grouped into those who reported (1) no high school degree or certificate, (2) a high school diploma or trade certificate, (3) a college certificate or diploma below bachelor's degree, or (4) a bachelor's degree or higher. Participants were asked whether they were currently employed or not. In addition, marital status was based on whether participants reported being (1) married or common-law status, (2) separated, (3) divorced, (4) widowed, or (5) single. Being married or in a common-law relationship was used as the referent.

**Analysis**

We used multilevel logistic regression to estimate the relationship between smoking relapse and social capital and network characteristics. Multilevel modeling was used to account for the clustering of participants within census tracts. We excluded observations if they were missing information on any study variables. We examined whether participants' social capital and network characteristics in 2008 predicted their smoking status in 2010. Three models were created. Model 1 contained the unadjusted relationships between 2010 smoking and social capital and network variables. Model 2 estimated the relationship between 2010 smoking status and social capital, isolation, and the number of smoking alters. Model 3 substituted the residential location of the smoking alters for the total number. Models 2 and 3 adjusted for participants' demographic and socioeconomic characteristics in 2008.

**RESULTS**

Table 1 provides the descriptive characteristics of the nonsmokers in 2008 that participated in the follow-up study (n = 1087). Among nonsmokers in 2008, 42 (3.9%) reported being current smokers in 2010. Ninety-four (8.7%) respondents reported not having any core network ties. In total, respondents reported 2620 alters, of which 373 smoked. Approximately 292 respondents (26.9%) reported having at least 1 smoking alter, with 44 respondents (4.0%) having a smoking alter in the household. Table 2

provides the unadjusted and adjusted odds ratios (ORs) and 95% confidence intervals (CIs) estimating the relationship between smoking relapse and social network variables. Social capital and social isolation at baseline were significant predictors of smoking relapse at follow-up in unadjusted and adjusted models. Model 3 showed that higher network social capital at baseline reduced the odds of smoking relapse (OR = 0.68; 95% CI = 0.47, 0.96). Social isolation at baseline increased the likelihood of smoking relapse (OR = 3.69; 95% CI = 1.36, 10.01). The number of smoking alters did not correspond to smoking relapse. Model 3 showed however that smoking alters who resided in a participant's household at baseline did increase the odds of smoking relapse (OR = 4.22; 95% CI = 1.52, 11.73). Smoking alters who resided outside a respondent's household had no influence on smoking relapse. Table A (available as a supplement to this article at <http://www.ajph.org>) includes the ORs and 95% CIs for the demographic and socioeconomic variables adjusted for in models 2 and 3. Only age was marginally related to smoking relapse.

**DISCUSSION**

In this study, we examined the importance of 3 types of social network influences on smoking relapse. Three main findings emerge from this study. First, network social capital reduced the risk of adult smoking relapse. Participants with greater network capital in 2008 were less likely to relapse into smoking in 2010. Second, our study revealed links between social isolation and adult smoking relapse. Adults who did not report any core social ties (i.e., anyone with whom to discuss important matters) in 2008 were at greater risk for smoking relapse in 2010. Third, the study showed that the overall number of smoking alters in a person's core network did not increase the risk of adult smoking relapse within the 2-year period. Instead, having smoking alters was related to relapse only if they resided in participants' households.

Previous research on adolescent smoking has suggested that youths with greater network diversity are at higher risk for being exposed to smoking behaviors and thus more likely to smoke.<sup>19</sup> Our study was not able to assess whether higher network capital resulted in greater exposure on average to smoking

**TABLE 1—Characteristics of Wave 2 Smoking Relapse Subsample (n = 1087): Montreal Neighborhood Networks and Healthy Aging (MoNNET-HA); Montreal, Quebec, 2010**

Variables	No. (%) or Mean ± SE
Smokers (2010)	42 (3.9)
Network social capital (2008)	0.12 ± 0.03
Social isolates (2008)	95 (8.7)
Smoking alters (2008; range = 0-3)	0.34 ± 0.02
Household-dwelling (2008)	0.04 ± 0.01
Neighborhood (2008)	0.11 ± 0.01
Outside neighborhood (2008)	0.19 ± 0.01
Women (2008)	689 (63.4)
Age, y (2008)	
25-34	136 (12.5)
35-44	206 (19.0)
45-54	221 (20.3)
55-64	201 (18.5)
65-74	225 (20.7)
≥ 75	98 (9.0)
Marital status (2008)	
Married	648 (59.6)
Single	190 (17.5)
Separated	41 (3.8)
Divorced	122 (11.2)
Widowed	86 (7.9)
Educational attainment (2008)	
< high school	83 (7.6)
High school or trade certificate	283 (26.0)
College diploma or equivalent	229 (21.1)
≥ university degree	492 (45.3)
Household income, CAN\$ (2008)	
< 28 000	163 (15.0)
28 000-49 000	271 (24.9)
50 000-74 000	321 (29.5)
75 000-100 000	154 (14.2)
> 100 000	178 (16.4)
Employed (2008)	615 (56.6)
Household language (2008)	
French	897 (82.5)
English	134 (12.3)
Foreign language	56 (5.2)

behaviors. Nevertheless, our results suggest that adults with greater network capital were less likely to relapse compared with those with lesser capital. Previous research has shown that inequalities in social capital and health can be attributed to a range of factors, including

**TABLE 2—Influence of Social Capital and Network Variables on Smoking Initiation in Follow-Up Smoking Relapse Subsample (n = 1087): Montreal Neighborhood Networks and Healthy Aging Study (MoNNET-HA); Montreal, Quebec, 2010**

Variables	Model 1, Unadjusted OR (95% CIs)	Model 2, Adjusted OR (95% CIs)	Model 3, Adjusted OR (95% CIs)
Network social capital (2008)	0.68* (0.58, 0.92)	0.69* (0.49, 0.98)	0.68* (0.47, 0.96)
Social isolation (2008)	2.59* (1.16, 5.77)	3.70* (1.38, 9.95)	3.69** (1.36, 10.01)
Smoking alters (2008)	1.39 (0.93, 2.10)	1.47 (0.95, 2.29)	...
Household dwelling	3.06* (1.19, 7.87)	...	4.22** (1.52, 11.73)
Neighborhood	0.87 (0.36, 2.11)	...	0.94 (0.38, 2.32)
Outside neighborhood	1.50 (0.86, 2.61)	...	1.42 (0.77, 2.62)

Note. CI = confidence interval; OR = odds ratio. Models 2 and 3 adjusted for sociodemographic and socioeconomic confounders.

\* $P < .05$ ; \*\* $P < .01$ .

education, social participation, and perceived control.<sup>25</sup> The protective aspects of network capital might emerge in part from the contribution of weak ties to the formation of network capital. Weak ties often serve as bridges between different social clusters, thereby providing individuals with a broader range of information and mobility opportunities.<sup>26</sup> Having more weak ties has also been linked to a higher degree of overall social integration<sup>26</sup> and a greater sense of personal autonomy.<sup>27</sup> Furthermore, weak ties might help lessen normative pressures that might develop within more homophilous and dense local networks,<sup>26</sup> particularly in those networks in which unhealthy behaviors (e.g., smoking) might be more prevalent.

With regard to social isolation, our study supports previous findings showing that social isolation might lead to smoking. Researchers have suggested that smoking might provide a means of managing depression or negative moods that might result from being socially isolated.<sup>19</sup> Similar psychological mechanisms might be at play when socially isolated adults relapse. Addressing social isolation as an upstream factor influencing smoking behavior might help reduce the negative effects of various psychological factors on smoking relapse. Finally, the study showed that having smoking alters in the network (i.e., in the neighborhood or beyond) was less important for smoking relapse than whether the smoking alter also resided with the person. Our findings in this regard parallel other studies that have shown the impact of a spouse on their partner's

smoking behavior.<sup>9,12</sup> Among those who reported a smoking alter in the household, 82% were married or in a common-law relationship. Marital status itself was not significant in our models because the more proximate effects of having a spouse or partner who smoked were captured in the household-smoker variable. Spousal ties are spatially and socially proximate because partners tend to reside together. Given the addictive properties of tobacco smoking and the importance of neural and visual cues in smoking relapse, spatial proximity might reinforce the influence of social proximity on smoking relapse.<sup>28</sup>

### Limitations

There were a number of limitations to this study. First, the study's smoking outcome was limited to those who reported being current smokers (i.e., smoking in the past 30 days) in both the 2008 and 2010 MoNNET-HA surveys. Analyses were unable to distinguish between adult smoking initiation and relapse. Yet, given research showing that smoking initiation tends to occur between the ages of 16 and 18 years among Canadians,<sup>29</sup> our study focuses on the concept of relapse as underpinning the behavior represented by adults older than 25 years reporting a change in their smoking status from 2008 to 2010. In our sample, the number of persons who relapsed was evenly distributed across the 4 youngest age groups, with 88.1% of those who relapsed being between 25 and 65 years old in 2008. Second, in terms of information on smoking levels, the study did not assess the smoking frequency of participants or that of

their alters. Discerning whether the smoking levels of either might impact smoking relapse was beyond this study and might be pursued in future research. Third, the sample consists of urban-dwelling adults residing in a Western, industrial country. Comparative research is needed to assess whether network capital operates in a similar fashion to reduce smoking relapse in rural or non-Western settings.

### Implications

This study is unique in its prospective analysis of the influence of network social capital on smoking relapse, thus providing greater support for network influences on adult smoking. Network capital helped to prevent relapse, before and after adjusting for a range of socioeconomic, demographic, and other network characteristics. Further research is needed to identify the specific protective mechanisms at play in the relationship between social capital and smoking relapse. Yet, compared with the extensive research that has shown the influence of social support on smoking, our study highlights the importance of network diversity in preventing relapse. By increasing network diversity, antismoking programs might leverage the protective benefits of network capital, such as greater overall social integration and sense of autonomy, to reduce smoking relapse among adults. ■

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### Contributors

S. Moore conceptualized the study and led the interpretation of results and writing. S. Stewart conducted statistical analyses. A. Teixeira and S. Stewart interpreted findings, assisted in drafting the article and revising it critically for intellectual content, and gave final approval of the version to be published.

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### Human Participant Protection

The Committee of Scientific Evaluation and Research Ethics of the Centre de Recherche at the Centre Hospitalier de l'Université De Montréal (CHUM; N.D. 07.049) gave ethics approval for the study.

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