

Published in final edited form as:

Drug Alcohol Depend. 2014 October 1; 143: 158–166. doi:10.1016/j.drugalcdep.2014.07.019.

Socioeconomic Status and Smokers' Number of Smoking Friends: Findings from the International Tobacco Control (ITC) Four Country Survey

Sara C. Hitchman^a, Geoffrey T. Fong^{b,c,d}, Mark P. Zanna^b, James F. Thrasher^e, Janet Chung-Hall^b, and Mohammad Siahpush^f

^aDepartment of Addictions, Institute of Psychiatry, King's College London, 4 Windsor Walk, London, United Kingdom, SE5 8BB

^bDepartment of Psychology, University of Waterloo, 200 University Avenue West Waterloo, Ontario, Canada, N2L 3G1

^cSchool of Public Health and Health Systems, University of Waterloo, 200 University Avenue West, Waterloo, Ontario, Canada, N2L 3G1

^dOntario Institute for Cancer Research, 101 College Street, Toronto, Ontario, Canada, M5G 1L7

^eDepartment of Health Promotion, Education, and Behavior, Arnold School of Public Health, University of South Carolina, 800 Sumter Street, Columbia, South Carolina, United States, 29208

^fCollege of Public Health, University of Nebraska Medical Center, 42nd and Emile, Omaha, Nebraska, United States, 68198-4355

Abstract

Background—Smoking rates are higher among low socioeconomic (SES) groups, and there is evidence that inequalities in smoking are widening over time in many countries. Low SES smokers may be more likely to smoke and less likely to quit because smoking is heavily concentrated in their social contexts. This study investigated whether low SES smokers (1) have more smoking friends, and (2) are more likely to gain and less likely to lose smoking friends over time. Correlates of having more smoking friends and gaining or losing smoking friends were also considered.

Method—Respondents included 6,321 adult current smokers (at recruitment) from Wave 1 (2002) and Wave 2 (2003) of the International Tobacco Control Project (ITC) Four Country

© 2014 Elsevier Ireland Ltd. All rights reserved.

Corresponding Author: Sara C. Hitchman, sara.hitchman@kcl.ac.uk, + 44 020 7848 0449.

Publisher's Disclaimer: This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

Contributors: Hitchman prepared the first version of the manuscript and analyzed the data. Hitchman, Fong, Zanna, and Thrasher made significant contributions to study design. Siahpush and Chung-Hall made contributions to study design. All authors participated in the preparation and review of the manuscript, and approved the final version.

Conflict of Interest: No conflict of interest declared.

Survey, a nationally representative longitudinal cohort survey of smokers in Australia, Canada, UK, and US.

Results—Low SES smokers reported more smoking friends than moderate and high SES smokers. Low SES smokers were also more likely to gain smoking friends over time compared with high SES smokers. Smokers who were male, younger, and lived with other smokers reported more smoking friends, and were also more likely to gain and less likely to lose smoking friends. Smoking behaviours, such as higher nicotine dependence were related to reporting more smoking friends, but not to losing or gain smoking friends.

Conclusions—Smoking is highly concentrated in the social networks of lower SES smokers and this concentration may be increasing over time. Cessation interventions should consider how the structure of low SES smokers' social networks affects quitting.

Keywords

smoking cessation; social context; social network; socioeconomic inequalities

1. INTRODUCTION

The high rate of smoking among low socioeconomic status (SES) groups illustrates the striking relation between the social context and health behaviour (Cavelaars et al., 2000; Huisman et al., 2005; Jarvis and Wardle, 2006). In 2009, smoking rates were twice as high among routine and manual workers (28%) in England compared with managerial and professional workers (14%; The NHS Information Centre: Lifestyle Statistics, 2011). Smoking rates are similarly high among low SES groups in other countries, including Australia, Canada, and the United States (Centers for Disease Control and Prevention, 2011; Reid et al., 2012; Smith and Leggat, 2007).

Smoking may be more prevalent among low SES groups due to a combination of factors, including targeted marketing by the tobacco industry, positive norms towards smoking, easier access to cigarettes, lower social support for quitting, higher nicotine dependence, life stress/psychological differences, and lower adherence to smoking cessation treatments (Hiscock et al., 2012). Low SES smokers might also be less likely to successfully quit if their social networks have a high proportion of smokers (Hiscock et al., 2011; Jarvis, 2004; Kotz and West, 2009; Rose et al., 1996; Wiltshire et al., 2003). Indeed, some of the factors contributing to high smoking rates in low SES groups, such as positive smoking norms, may be related to having a social network with more smokers (Christakis and Fowler, 2009; Ellickson, 2001; Horne, 2001; Levine and Moreland, 1990; Shiffman and Rathbun, 2011).

Despite the impact that smoking in social networks may have on quit success among low SES smokers, only a few studies have examined whether there are SES differences in adult smokers' number of smoking friends. Rose et al. (1996) found that young adult smokers with low education from the mid-Western US reported more smoking friends. Additionally, although differences in number of smoking friends were not explicitly addressed, a 32-year social networking study conducted in Framingham, Massachusetts, US, found evidence of increasing stigmatisation of smoking in high SES groups, such that over time, smokers with

higher education moved to the periphery of their social networks (Christakis and Fowler, 2008).

This study sought to expand the literature by examining whether low SES smokers (low education and low income) have more friends who smoke among nationally representative samples of smokers from Australia, Canada, the United Kingdom (UK), and the United States (US). Because previous research shows that losing smoking friends predicts quit success (Hitchman et al., 2014 In Press), this study also sought to expand the literature by examining whether low SES smokers are more likely to gain and less likely to lose smoking friends over time.

Because people are generally friends with similar others, low SES smokers were expected to report more smoking friends (Blieszner and Adams, 1992; McPherson et al., 2001). Low SES smokers were also expected to be more likely to gain and less likely to lose smoking friends over time, due to higher smoking rates and lower smoking cessation rates among low SES groups (Harper and Lynch, 2007; Smith et al., 2009). For other demographics included the analyses, it was expected that other groups with higher smoking rates and lower cessation rates (e.g., younger smokers) would also report more smoking friends, and be more likely to gain and less likely to lose smoking friends over time.

Variables previously shown to predict smoking cessation outcomes were included in the analyses to control for their potential influence on number of smoking friends and changes in smoking friends over time (Hyland et al., 2006; Vangeli et al., 2011). For example, smokers with intentions to quit may avoid smoking friends in preparation for a quit attempt. The relation between these smoking cessation predictor variables and number of smoking friends and changes in smoking friends was subsequently considered. It was expected that the smoking cessation predictor variables that have been previously shown to be related to a higher likelihood of quitting (lower nicotine dependence, previous quit attempts) would be related to having fewer smoking friends and losing smoking friends over time (Hyland et al., 2006).

Demographic and country differences in the relation between SES, and number of smoking friends and changes in number of smoking friends over time were also considered. It was thought that for younger smokers, SES differences in number of smoking friends may not be as pronounced due to the importance of smoking for socializing (Fidler and West, 2009). No country differences were expected.

Changes in smoking status were then considered to test for the possibility that SES may only be related to changes in smoking friends over time because SES is related to changes in smoking status. For example, it could be that high SES and losing smoking friends may only be related because high SES smokers are more likely to quit smoking, and quitting smoking is related to losing smoking friends.

Finally, the potential influence of living with non-smoking adults was examined. Household composition of smokers was not considered in the initial analyses because the influence of smoking friends was the primary interest. Smokers who lived with non-smoking adults were

expected to have fewer smoking friends, and be more likely to lose and less likely to gain smoking friends over time.

2. METHODS

2.1 Respondents

The International Tobacco Control (ITC) Four Country Survey is a nationally representative longitudinal cohort survey of current adult smokers at recruitment (100 lifetime cigarettes and smoked at least once in the past 30 days) in Australia, Canada, UK, and US, who were recruited using random digit dialing methods starting in 2002. The current study used the Wave 1 – Wave 2 longitudinal sample (N=6,682). The Wave 1 – Wave 2 follow-up rates were 81% in Australia, 76% in Canada, 78% in the UK, and 63% in the US. Data collection involved Computer Assisted Telephone Interviewing, with Wave 1 data collected between October and December of 2002, and Wave 2 between May and September of 2003. A mean of 6.7 months separated the surveys. This time period has been shown to be sufficient for showing a relation between changes in smoking friends over time and smoking cessation outcomes, thus it was deemed adequate for the present study (Hitchman et al., 2014 In Press). Respondents with missing or “don’t know” responses were deleted. The final sample size was (N=6,321). Further details on methodology are available elsewhere (Fong et al., 2006; ITC Project, 2004, 2011; Thompson et al., 2006).

2.2 Measures

2.2.1 Outcome Variables

Number of smoking friends at Wave 1: Respondents were asked: Of the five closest friends or acquaintances that you spend time with on a regular basis, how many of them are smokers (0, 1, 2, 3, 4, or 5)?

Change in number of smoking friends between Wave 1 and Wave 2 (friend change):

Friend change was calculated as the difference between number of smoking friends at Wave 1, and number of smoking friends at Wave 2 (Wave 2 measure same as Wave 1 measure above); an 11-category variable was derived that ranged from a loss of five friends (–5), to no change (0), to a gain of five friends (5). From the 11-category variable, a 3-category variable was derived that was used in all analyses: loss, no change, or gain in number of smoking friends. All analyses that included friend change controlled for number of smoking friends at Wave 1, because the number of friends that respondents could lose/gain depended on the number with which they started.

2.2.2 Key Predictor Variables at Wave 1

2.2.2.1 Demographics

Country, sex, age group, ethnicity: Data on sex (female vs. male) and age (18–24, 25–39, 40–54, or 55+) were collected. Countries included Australia, Canada, UK, and US. Ethnicity was categorised based on methods from each country’s census. In Canada, UK, and US, white was categorised as the majority group, and non-white as the minority group. In

Australia, English spoken in the home was categorised as the majority group, and language other than English as the minority group.

Education, annual household income (gross), and employment outside the home:

Education was categorised as highest level achieved: low=high school or less; moderate=technical, trade school, or community college (some or completed), or some university; and high=at least a university degree, and 'no answer' (due to a high number of refusals and don't knows). In Australia, Canada, and US, income was categorised as: low = under \$30,000, moderate = \$30,000-\$59,999, and high = \$60,000 or higher (each country's dollars). In the UK, income was categorised as: low = under £30,000, moderate = £30,000-£44,999, and high = £45,000 or higher. Respondents were also asked if they were employed outside the home (yes vs. no).

2.2.2.2 Smoking Cessation Predictor Variables

Smoking status, heaviness of smoking (HSI), quit attempts, intentions to quit, and longest quit attempt: Smoking status was categorised as: daily vs. weekly/monthly. HSI is a composite measure of nicotine dependence, consisting of cigarettes per day (0–10, 11–20, 21–30, or >30), and minutes to first cigarette after waking (<5, 6–30, 31–60, or >60), ranging from 0 to 6 for low to high dependence (Heatherton et al., 1989). Respondents were asked if they made any attempts to stop smoking in the last year (yes vs. no). For intentions to quit, smokers were asked: 'Are you planning to quit smoking'? Response options were 'in the next month', 'in the next six months', 'beyond six months', and 'not planning to quit'. Intentions to quit were coded as: intention to quit within the next six months vs. otherwise. Don't know was coded as no intentions/otherwise. Longest quit attempt ever was categorised as: never, one week or less, more than one week but less than six months, or six months or more.

Outcome expectancy of quitting: Respondents were asked: 'How much do you think you would benefit from health and other gains if you were to quit smoking permanently in the next six months?' Response options were 'not at all', 'slightly', 'moderately', 'very much', or 'extremely'.

Worried smoking will damage health: Respondents were asked: 'How worried are you, if at all, that smoking will damage your health in the future?' Response options were 'not at all worried', 'a little worried', 'moderately worried', or 'very worried'.

2.2.3 Predictor Variables used for Additional Analyses

Household smokers at Wave 1: Household smokers at Wave 1 was categorised as: single adult smoker, all adult smokers, or mixed adult smokers and non-smokers.

Smoking status at Wave 2: Smoking status was categorised as: daily, weekly, monthly, quit less than one month, quit one to six months, quit more than six months.

2.3 Analyses

Analyses were conducted using SAS 9.2 and used survey weights that were computed using estimated population values from national benchmark surveys (ITC Project, 2004, 2011; Thompson et al., 2006). The longitudinal Wave 1 – Wave 2 weights were adjusted for Wave 1-Wave 2 attrition (for further details see; ITC Project, 2004, 2011; Thompson et al., 2006).

All measures were treated as categorical variables. The exceptions were (a) HSI, (b) outcome expectancy of quitting, and (c) worried smoking will damage health, which were treated as quantitative variables.

To test whether SES was related to smokers' number of smoking friends at Wave 1, a multivariable regression analysis was conducted with number of smoking friends at Wave 1 set as the dependent variable, and all demographic and smoking cessation predictor variables at Wave 1 included as covariates. Smoking cessation predictor variables were included as covariates to control for the possibility that intentions to quit, or other smoking behaviours or beliefs, might lead people to select or de-select friends who smoke.

To test whether SES was related to changes in number of smoking friends between Wave 1 and Wave 2, separate multinomial logistic regression analyses were conducted with friend change set as the dependent variable (loss vs. gain, loss vs. no change, and gain vs. no change), with all demographic characteristics and smoking cessation predictor variables at Wave 1 included as covariates, plus smoking friends at Wave 1.

Tests of interactions were also conducted to determine if (a) correlates of number of smoking friends, and changes in number of smoking friends differed across countries, by age, sex, education, or income (country x age; country x sex; country x education; country by income), and (b) if any relation between SES, and number of smoking friends, and changes in number of smoking friends over time differed by age group (age group x SES).

In separate analyses, smoking status at Wave 2 was added as a covariate to test for the possibility that correlates of changes in number of smoking friends were only significant because they were related to a change in smoking status. Lastly, composition of household smokers was added to the models to examine its relation with number of smoking friends and changes in number of smoking friends over time.

3. RESULTS

3.1 Characteristics of respondents at Wave 1

Table 1 presents key demographic characteristics of the sample collected at recruitment (Wave 1), along with number of smoking friends at Wave 1, and changes in smoking friends between Wave 1 and Wave 2. There were significant differences in the number of low, moderate, and high SES respondents in each country. Across countries the percentage of low SES respondents ranged from 40.8%–66.9% for education, and 27.3%–35.5% for income ($p < 0.0001$). Although the 3-category friend change variable was used in all analyses (loss vs. no change vs. gain), the frequencies for the 11-category friend change variable are presented in Table 1 to illustrate its distribution. Differences between respondents (Wave 1 –

Wave 2 sample) and those lost to follow-up at Wave 2 were examined for the characteristics in Table 1, and intentions to quit. Respondents who lived in the US, were of younger age, were from a minority group (except in the UK), had lower education (in Canada and the US), were male (in the US), and reported more smoking friends were significantly more likely to be lost to follow-up (all $p < .05$).

3.2 Number of smoking friends at Wave 1, and demographic characteristics and smoking cessation predictor variables at Wave 1

Table 2 presents the results of the multivariable regression analysis that examined the demographic characteristics and the smoking cessation predictor variables at Wave 1 that were related to reporting a higher number of smoking friends at Wave 1. Respondents from Canada, US, and UK reported more smoking friends at Wave 1 than smokers from Australia. Other demographic characteristics that were related to having more smoking friends at Wave 1 included (relative to comparison group): being male, younger age, lower education, and lower income. Smoking cessation predictor variables that were related to having more smoking friends included (relative to comparison group): being a daily smoker, heavier smoking, never making a quit attempt vs. made an attempt that lasted six months or longer, having no intention to quit smoking, and having a lower outcome expectancy of the benefits of quitting. Tests of interactions indicated that the correlates of number of smoking friends did not differ across countries by sex, age, education, or income, ($p = .07$; $p = .07$; $p = .31$; and $p = .59$), respectively, and that number of smoking friends by age did not differ across SES groups (income, $p = .10$, and education, $p = .98$).

3.3 Changes in number of smoking friends between Wave 1 and Wave 2, and demographics and smoking cessation predictor variables at Wave 1

Table 3 presents the results of the multinomial logistic regression analyses examining the predictors of experiencing no change vs. a loss, a gain vs. no change, and a gain vs. a loss in number of smoking friends between Wave 1 and Wave 2. For demographic characteristics the following respondents were more likely to lose than experience no change in smoking friends: lived in the US vs. Australia, older, and were employed outside the home. For the smoking cessation predictor variables there were no differences in losing compared with experiencing no change in smoking friends. For demographic characteristics the following respondents were more likely to gain than experience no change in smoking friends: male, younger, lower education, and lower income. For smoking cessation predictor variables, respondents who were less worried that smoking will damage their health in the future, were more likely to gain than experience no change in smoking friends. For demographic characteristics the following respondents were more likely to gain than lose smoking friends: younger, lower education, and lower income. For smoking cessation predictor variables, respondents who were less worried that smoking will damaged their health in the future, were more likely to gain than lose smoking friends. Tests of interactions indicated that across countries, there were no significant differences in changes in number of smoking friends by sex, age, education, or income, ($p = .20$; $p = .45$; $p = .18$; and $p = .57$ respectively), and that there were no significant differences in changes of number of smoking friends by age across SES groups (income, $p = .63$ and education, $p = .19$).

3.4 Changes in number of smoking friends between Wave 1 and Wave 2, and smoking status at Wave 2

The multinomial logistic regression analyses examining the relation between SES and changes in number of smoking friends, with demographic characteristics and smoking cessation predictor variables included as covariates, with the addition of Wave 2 smoking status, found that there were no changes in the overall significance of the variables in the models. Smoking status itself at Wave 2 was significantly related to change in number of smoking friends, such that, the longer that a smoker reported being quit, the more likely they were to have experienced a loss vs. no change/gain in their number of smoking friends, and the less likely they were to have experienced a gain vs. a loss in smoking friends. Interestingly, monthly/weekly smokers were more likely to experience any change (loss or gain vs. no change) in their number of smoking friends compared with daily smokers. Results are presented in Table 4.

3.5 Household smokers at Wave 1, and number of smoking friends at Wave 1, and changes in number of smoking friends between Wave 1 and Wave 2

Household smokers was significantly related to smokers' number of smoking friends. Smokers who were the only smoking adult in their household reported more smoking friends than smokers from mixed smoker and non-smoker households. Similarly, smokers from all adult smoker households reported more smoking friends than smokers from mixed smoker and non-smoker households; an additional analysis (not shown in tables) showed that smokers from all adult smoker households reported more smoking friends than adults from single adult smoker households ($\beta = 0.41$, 95% CI = 0.29–0.53; $p < .0001$). Results are presented in Table 5.

Household smokers was also related to changes in number of smoking friends over time. Compared with smokers from mixed smoker and non-smoker households, smokers from all adult smoker households were more likely to gain smoking friends than experience no change in their number of smoking friends over time. Smokers from adult smoker households were also more likely to gain than lose smoking friends over time compared with those from mixed smoker and non-smoker households. There were no significant differences between changes in number of smoking friends over time between smokers from mixed smoker and non-smoker households, and single adult smoker households. Results are presented in Table 6.

4. DISCUSSION

This is the first study to systematically examine whether smokers' number of smoking friends and changes in their number of smoking friends over time are related to SES, demographics, and smoking cessation predictor variables. As expected, low SES smokers (low income, low education) reported a higher number of smoking friends. Low SES smokers were also more likely to gain than lose smoking friends over time, and more likely to gain than experience no change in smoking friends. Although not intended to be a measure of SES, smokers who were not employed outside the home were less likely to lose than experience no change in smoking friends.

Other demographic characteristics and smoking cessation predictor variables were also related to reporting a higher number of smoking friends. As expected, younger smokers reported more smoking friends. Male smokers unexpectedly reported more smoking friends, possibly because of their slightly higher smoking rates. It is unclear why smokers from Australia reported fewer smoking friends. It may be the case that despite similar smoking rates across countries, smokers in the US, the UK, and Canada were more likely to live in social contexts where smoking is heavily concentrated. As expected, smokers with more smoking friends were more likely to be daily smokers, be highly nicotine dependent, report a shorter time ever off smoking, and report no intentions to quit.

In addition to SES, other demographics were also related to changes in number of smoking friends over time. As expected, younger smokers were more likely to gain and less likely to lose/experience no change in smoking friends. Unexpectedly, male smokers were more likely to gain smoking friends than experience no change in smoking friends, again, perhaps due to their slightly higher smoking rates.

Interestingly, worry about the future health damages of smoking was the only smoking cessation predictor variable that was related to changes in smoking in friends. No other smoking cessation predictor variables (intentions to quit, heaviness of smoking, attempt to quit in past year, longest quit attempt, outcome expectancy of quitting) were related to changes in smoking friends; this suggests that SES and other demographics may be more important determinants of changes in smoking friends than individual level predictors of smoking cessation. Indeed, this finding suggests that demographics, particularly SES, are powerful determinants of the concentration of smoking in people's social contexts, independent of individual's own smoking behaviour.

There were no differences in the relation between SES and number of friends or changes in smoking friends by age group or country, suggesting that the relations found may be universal across the age groups and countries studied.

Changes in smoking status did not explain the relation between changes in smoking friends and SES, or any of the other variables. However, changes in smoking status were related to changes in smoking friends, suggesting that quitting smoking coincides with losing smoking friends, and continuing smoking coincides with gaining smoking friends. Interestingly, monthly smokers at Wave 2 were more likely to have experienced any change in their number of smoking friends (loss or gain) compared with daily smokers, perhaps due to the more occasional/context dependent nature of monthly smoking.

Smokers who lived with other adult smokers, or who were the only adult in the household, reported more smoking friends than those who lived with adult non-smokers. Compared with smokers who were the only adult, smokers who lived with other adult smokers were more likely to gain than lose smoking friends over time, whereas respondents who lived with adult non-smokers were more likely to lose smoking friends over time. Living with other smokers may facilitate social connections with smokers, whereas living with non-smokers may limit them.

4.1 Implications

(Hitchman et al., 2014 In Press) demonstrated the importance of the social context in the smoking cessation process: smokers with fewer smoking friends, and those who lost smoking friends over time were more likely to successfully quit. The current study shows that the social context is related to SES, and increasingly so over time. Thus, smoking cessation interventions should advise smokers, especially low SES smokers, to reduce the number of smokers in their social contexts. However, because there is no research on whether advising low SES smokers to avoid smokers when attempting to quit leads to changes in the number of smokers in their social contexts, further research should investigate the effectiveness of this advice. For example, qualitative research suggests that low SES smokers may experience significant challenges in following advice to avoid other smokers due to the 'cultures of smoking' that they inhabit (Wiltshire et al., 2003). Additionally, the current study found that intentions to quit smoking and other smoking cessation predictor variables were not related to losing smoking friends, suggesting that even if smokers intend to quit they may be unable or unmotivated to reduce the number of smokers in their social contexts.

Future research could explore whether social media could help offset some of the negative effects of having more smoking friends by connecting low SES smokers with other smokers who want to quit. Coping mechanisms to deal with exposure to other smokers (i.e., smoking cues) could also be emphasized, such as fast acting nicotine replacement therapy (NRT) to deal with cravings during quit attempts (Sweeney et al., 2001), and long-term use of NRT to maintain abstinence (Agboola et al., 2010).

4.2 Limitations

First, no causal relation can be established between the variables examined, and having more smoking friends, and experiencing changes in smoking friends over time. Second, the number of smoking friends measure is somewhat limited because it asked about friends that respondents spend time with on a regular basis, and set the number of friends to five. It is possible that some people thought about family, while others thoughts were about friends or co-workers (Thrasher et al., 2011). However, despite challenges to the reliability of the measure, any unreliability cannot, in and of itself, explain statistically the significant results whose direction and magnitude fit with the hypothesized results. Third, attrition analysis showed that smokers with lower education, lower income, and more smoking friends were significantly more likely to be lost to follow-up; the analyses may therefore underrepresent these groups. Finally, because self-reported data were used, there is potential for bias. For example, social desirability bias could have led high SES smokers to report fewer smoking friends. However, it is unlikely that this alone could explain the results, particularly the relation between SES and changes in smoking friends over time.

Acknowledgments

Funding Source: This research was supported by Canadian Institutes for Health Research (57897, 79551, and 115016), Robert Wood Johnson Foundation (045734), Cancer Research UK (C312/A3726, C312/A6465, C312/A11039, and C312/A11943), Commonwealth Department of Health and Aging, Canadian Tobacco Control Research Initiative (014578), National Health and Medical Research Council of Australia (265903 and 450110), U.S. National Cancer Institute (P50 CA111236) and (RO1 CA100362), Ontario Institute for Cancer Research

(Senior Investigator Award), Ontario Institute for Cancer Research (Senior Investigator Award), Canadian Institutes of Health Research Doctoral Research Award.

Role of Funding Source in Study: None. The funding sources played no role in the study design; in the collection, analysis and interpretation of data; in the writing of the article; and in the decision to submit it for publication.

REFERENCES

- Agboola S, McNeill A, Coleman T, Leonardi Bee J. A systematic review of the effectiveness of smoking relapse prevention interventions for abstinent smokers. *Addiction*. 2010; 105:1362–1380. [PubMed: 20653619]
- Blieszner, R.; Adams, RG. *Adult Friendship*. London: SAGE Publications; 1992.
- Cavelaars AEJM, Kunst AE, Geurts JJM, Crialessi R. Educational differences in smoking: international comparison. *BMJ*. 2000; 320:1102–1107. [PubMed: 10775217]
- Centers for Disease Control and Prevention. *CDC Health Disparities and Inequalities Report - United States*, 2011. *Morb. Mortal. Wkly. Rep.* 2011; 60(Suppl)
- Christakis NA, Fowler JH. The collective dynamics of smoking in a large social network. *N. Engl. J. Med.* 2008; 358:2249–22458. [PubMed: 18499567]
- Christakis, NA.; Fowler, JH. 1st Ed.. New York: Hachette Book Group; 2009. *Connected: The Surprising Power Of Social Networks And How They Shape Our Lives*.
- Ellickson, RC. The evolution of social norms: a perspective from the legal academy. In: Hechter, M.; Opp, K-D., editors. *Social Norms*. New York, New York, USA: Russell Sage Foundation; 2001. p. 35-75.
- Fong GT, Cummings KM, Borland R, Hastings G, Hyland A, Giovino GA, Hammond D, Thompson ME. The conceptual framework of the International Tobacco Control (ITC) Policy Evaluation Project. *Tob. Control*. 2006; 15(Suppl. 3):ii3–ii11.
- Harper S, Lynch J. Trends in socioeconomic inequalities in adult health behaviors among US states, 1990–2004. *Public Health Rep.* 2007; 122:177–189. [PubMed: 17357360]
- Heatherton TF, Kozlowski LT, Frecker RC, Rickert W, Robinson J. Measuring the heaviness of smoking: using self-reported time to the first cigarette of the day and number of cigarettes smoked per day. *Br. J. Addict.* 1989; 84:791–799. [PubMed: 2758152]
- Hiscock R, Bauld L, Amos A, Fidler JA, Munafò M. Socioeconomic status and smoking: a review. *Ann. N. Y. Acad. Sci.* 2012; 1248:107–123. [PubMed: 22092035]
- Hiscock R, Judge K, Bauld L. Social inequalities in quitting smoking: what factors mediate the relationship between socioeconomic position and smoking cessation? *J. Public Health (Bangkok)*. 2011; 33:39–47.
- Hitchman SC, Fong GT, Zanna MP, Thrasher JF, Laux FL. The relation between number of smoking friends, and quit intentions, attempts, and success: findings from the International Tobacco Control (ITC) Project Four Country Survey; *Psychol. Addict. Behav.* Advanced online publication. 2014
- Horne, C. Sociological perspectives on the emergence of norms. In: Hechter, M.; Opp, K-D., editors. *Social Norms*. New York: Russell Sage Foundation; 2001. p. 3-34.
- Huisman M, Kunst A, Mackenbach J. Educational inequalities in smoking among men and women aged 16 years and older in 11 European countries. *Tob. Control*. 2005; 14:106–113. [PubMed: 15791020]
- Hyland A, Borland R, Li Q, Yong H-H, McNeill A, Fong GT, O'Connor RJ, Cummings KM. Individual-level predictors of cessation behaviours among participants in the International Tobacco Control (ITC) Four Country Survey. *Tob. Control*. 2006; 15(Suppl. 3):ii83–ii94.
- ITC Project. International Tobacco Control Policy Evaluation Survey (ITC 4-Country Survey): Wave 1 Technical Report [WWW Document]. 2004. URL <http://www.itcproject.org/documents/keyfindings/technicalreports/itcw1techreportfinalpdf> [accessed 3.8.12]
- ITC Project. [accessed 3.8.12] International Tobacco Control Policy Evaluation Survey (ITC): Four Country Project Waves 2–8 Technical Report [WWW Document]. 2011. URL http://www.itcproject.org/documents/keyfindings/4cw28techreportmay2011_2_pdf
- Jarvis MJ. Why people smoke. *BMJ*. 2004; 328:277–279. [PubMed: 14751901]

- Jarvis, MJ.; Wardle, J. Social patterning of individual health behaviours: the case of cigarette smoking. In: Marmot, M.; Wilkinson, RG., editors. *Social Determinants of Health*. New York: Oxford University Press; 2006. p. 224-237.
- Kotz D, West R. Explaining the social gradient in smoking cessation: it's not in the trying, but in the succeeding. *Tob. Control*. 2009; 18:43–46. [PubMed: 18936053]
- Levine JM, Moreland RL. Progress in small group research. *Annu. Rev. Psychol.* 1990; 41:585–634.
- McPherson M, Smith-Lovin L, Cook JM. Birds of a feather: homophily in social networks. *Annu. Rev. Sociol.* 2001; 27:415–444.
- Reid, JL.; Hammond, D.; Burkhalter, R.; Ahmed, R. *Tobacco Use in Canada: Patterns and Trends*. Waterloo, Ontario: University of Waterloo; 2012.
- Rose JS, Chassin L, Presson CC. Demographic factors in adult smoking status: mediating and moderating influences. *Psychol. Addict. Behav.* 1996; 10:28–37.
- Shiffman S, Rathbun SL. Point process analyses of variations in smoking rate by setting, mood, gender, and dependence. *Psychol. Addict. Behav.* 2011; 25:501–510. [PubMed: 21480683]
- Smith DR, Leggat PA. Tobacco smoking by occupation in Australia: results from the 2004 to 2005 National Health Survey. *J. Occup. Environ. Med.* 2007; 49:437–445. [PubMed: 17426527]
- Smith P, Frank J, Mustard C. Trends in educational inequalities in smoking and physical activity in Canada: 1974–2005. *J. Epidemiol. Community Health.* 2009; 63:317–323. [PubMed: 19147632]
- Sweeney CT, Fant RV, Fagerstrom KO, McGovern JF, Henningfield JE. Combination nicotine replacement therapy for smoking cessation. *CNS Drugs.* 2001; 15:453–467. [PubMed: 11524024]
- The NHS Information Centre: *Lifestyle Statistics*. England: Statistics on Smoking; 2011.
- Thompson ME, Fong GT, Hammond D, Boudreau C, Driezen P, Hyland A, Borland R, Cummings KM, Hastings GB, Siahpush M, Mackintosh AM, Laux FL. Methods of the International Tobacco Control (ITC) Four Country Survey. *Tob. Control.* 2006; 15(Suppl. 3):ii12–ii18.
- Thrasher JF, Quah ACK, Borland R, Driezen P, Omar M, Hosking W, Sirirassamee B, Boado M. Using cognitive interviewing and behavioral coding to determine measurement equivalence across linguistic and cultural groups: an example from the International Tobacco Control Policy Evaluation Project. *Field Methods.* 2011; 23:439–460.
- Wiltshire S, Bancroft A, Parry O, Amos A. “I came back here and started smoking again”: perceptions and experiences of quitting among disadvantaged smokers. *Health Educ. Res.* 2003; 18:292–303. [PubMed: 12828231]

Table 1

Characteristics of Wave 1 - Wave 2 Longitudinal Sample (N=6,321, unweighted)

Country	Australia (N=1,748)	Canada (N=1,595)	United Kingdom (N=1,714)	United States (N=1,264)
Variable	n	%	n	%
Sex				
Female	942	53.9%	885	55.5%
Male	806	46.1%	710	44.5%
Age group**				
18–24	252	14.4%	201	12.6%
25–39	639	36.6%	513	32.2%
40–54	621	35.5%	583	36.6%
55–max	236	13.5%	298	18.7%
Education**				
Low	1169	66.9%	717	45.0%
Moderate	355	20.3%	657	41.2%
High	224	12.8%	221	13.9%
Income**				
Low	477	27.3%	451	28.3%
Medium	594	34.0%	567	35.5%
High	571	32.7%	465	29.2%
No answer	106	6.1%	112	7.0%
Ethnicity**				
Non-white, other language	211	12.1%	169	10.6%
White, English only	1537	87.9%	1426	89.4%
Smoking status*				
Daily	1577	90.2%	1461	91.6%
Weekly/Monthly	171	9.8%	134	8.4%
Number of smoking friends at Wave 1				
0	228	13.0%	201	12.6%
			227	13.2%
			174	13.8%

Country	Australia (N=1,748)		Canada (N=1,595)		United Kingdom (N=1,714)		United States (N=1,264)	
Variable	n	%	n	%	n	%	n	%
1	236	13.5%	208	13.0%	230	13.4%	166	13.1%
2	341	19.5%	316	19.8%	331	19.3%	240	19.0%
3	376	21.5%	328	20.6%	319	18.6%	247	19.5%
4	221	12.6%	213	13.4%	234	13.7%	152	12.0%
5	346	19.8%	329	20.6%	373	21.8%	285	22.5%
Friend change between Wave 1 and Wave 2 *								
-5	5	0.3%	1	0.1%	12	0.7%	9	0.7%
-4	14	0.8%	23	1.4%	18	1.1%	15	1.2%
-3	57	3.3%	61	3.8%	58	3.4%	54	4.3%
-2	137	7.8%	125	7.8%	149	8.7%	118	9.3%
-1	291	16.6%	313	19.6%	307	17.9%	237	18.8%
No change	713	40.8%	628	39.4%	689	40.2%	471	37.3%
1	330	18.9%	260	16.3%	287	16.7%	207	16.4%
2	128	7.3%	128	8.0%	120	7.0%	100	7.9%
3	49	2.8%	39	2.4%	50	2.9%	30	2.4%
4	11	0.6%	8	0.5%	16	0.9%	18	1.4%
5	13	0.7%	9	0.6%	8	0.5%	5	0.4%

*** Pearson χ^2 test significantly different across countries at $p<0001$

* significantly different across countries at $p<05$

Table 2Predictors of Number of Smoking Friends at Wave 1 – Multivariable Model, (N=6,321)^a

Parameter	n	Mean # of Smoking Friends ^b	95% CI of Mean ^c	Estimate	Standard Error	95% CI of Estimate ^c	p-value
Intercept	6321	2.81	2.77,2.86	3.92	0.14	3.64,4.20	<0.0001
Country							
Australia	1748	2.77	2.68,2.85				
Canada	1595	2.80	2.71,2.89	0.12	0.06	0.01,0.24	0.040
United Kingdom	1714	2.87	2.79,2.96	0.21	0.06	0.09,0.33	0.001
United States	1264	2.81	2.71,2.92	0.14	0.07	0.01,0.27	0.034
Sex							
Female	3549	2.75	2.69,2.81				
Male	2772	2.87	2.81,2.94	0.11	0.05	0.02,0.20	0.015
Age group							
18–24	715	3.58	3.47,3.70				
25–39	2003	3.00	2.92,3.07	-0.53	0.07	-0.67,-0.39	<0.0001
40–54	2306	2.67	2.60,2.75	-0.93	0.07	-1.08,-0.78	<0.0001
55-max	1297	2.29	2.18,2.39	-1.47	0.09	-1.64,-1.30	<0.0001
Education							
Low	3511	2.93	2.87,2.99				
Moderate	1979	2.76	2.68,2.84	-0.18	0.05	-0.28,-0.08	0.001
High	831	2.40	2.28,2.52	-0.40	0.07	-0.54,-0.26	<0.0001
Household income							
Low	1894	2.95	2.87,3.03				
Moderate	2200	2.84	2.76,2.91	-0.13	0.06	-0.24,-0.02	0.022
High	1813	2.63	2.55,2.71	-0.31	0.06	-0.43,-0.19	<0.0001
No answer	414	2.95	2.77,3.13	-0.04	0.10	-0.23,0.15	0.655
Ethnicity							
White, English only	5608	2.82	2.77,2.87				
Non-white, non-English	713	2.75	2.61,2.89	-0.06	0.07	-0.21,0.08	0.391
Employed outside home							

Parameter	n	Mean # of Smoking Friends ^b	95% CI of Mean ^c	Estimate	Standard Error	95% CI of Estimate ^c	p-value
Yes	4065	2.84	2.79,2.90				
No	2256	2.76	2.68,2.84	-0.01	0.05	-0.10,0.10	0.976
Smoking status							
Daily	5792	2.84	2.79,2.89				
Weekly/monthly	529	2.48	2.33,2.63	-0.19	0.09	-0.36,-0.02	0.029
Heaviness of smoking							
0 - low dependence	911	2.55	2.44,2.67	0.09	0.02	0.05,0.12	<0.0001
1	680	2.75	2.60,2.89				
2	1072	2.83	2.72,2.94				
3	1806	2.81	2.72,2.89				
4	1084	2.92	2.81,3.02				
5	562	2.90	2.75,3.06				
6 - high dependence	206	3.24	3.00,3.47				
Attempt to quit in past year							
No attempt to quit	3677	2.76	2.70,2.82				
Attempt to quit	2644	2.88	2.81,2.95	0.10	0.05	-0.01,0.21	0.056
Longest quit attempt							
Never attempted	1180	2.97	2.87,3.07				
<1 week	1021	2.95	2.83,3.06	-0.10	0.08	-0.26,0.07	0.244
>1 week but < 6 months	1941	2.84	2.76,2.92	-0.12	0.07	-0.26,0.03	0.108
>6 months	2179	2.64	2.56,2.71	-0.14	0.07	-0.27,-0.01	0.037
Quit intentions (Wave 1)							
No intention	4058	2.89	2.83,2.94				
Intention	2263	2.68	2.61,2.75	-0.17	0.05	-0.28,-0.07	0.001
Outcome expectancy of quitting							
Not at all	394	3.02	2.84,3.21	-0.05	0.02	-0.09,-0.01	0.039
Slightly	790	2.78	2.65,2.91				
Moderately	1233	2.78	2.68,2.88				
Very much	2087	2.83	2.75,2.90				

Parameter	n	Mean # of Smoking Friends ^b	95% CI of Mean ^c	Estimate	Standard Error	95% CI of Estimate ^c	p-value
Extremely	1817	2.79	2.70,2.88				
Worried smoking will damage health							
Not all worried	774	2.96	2.83,3.10	-0.03	0.03	-0.08,-0.01	0.254
A little worried	1497	2.86	2.77,2.95				
Moderately worried	1992	2.68	2.60,2.76				
Very worried	2058	2.85	2.77,2.93				

^a unweighted frequencies

^b weighted means

^c CI = Confidence Interval

Table 3

Wave 1 Predictors of Friend Change Between Wave 1 and Wave 2, Multivariable Model, (N=6,321)

Parameter	<i>Changes in Number of Smoking Friends Between Wave 1 and Wave 2</i>							
	Event = loss, (vs. no change)				Event = gain, (vs. loss)			
	OR ^a	95% CI ^b	p-value	OR ^a	95% CI ^b	p-value	OR ^a	95% CI ^b
Country								
Australia	1.00	1.00	ref ^c	1.00	1.00	ref	1.00	1.00
Canada	1.20	0.99,1.45	0.069	0.97	0.80,1.19	0.787	0.81	0.65,1.02
United Kingdom	0.91	0.75,1.11	0.362	0.91	0.75,1.11	0.341	0.99	0.80,1.24
United States	1.33	1.07,1.64	0.009	1.05	0.84,1.30	0.68	0.79	0.62,1.00
Sex								
Female	1.00	1.00	ref	1.00	1.00	ref	1.00	1.00
Male	1.10	0.95,1.26	0.208	1.17	1.01,1.36	0.038	1.07	0.91,1.26
Age group								
18–24	1.00	1.00	ref	1.00	1.00	ref	1.00	1.00
25–39	1.27	0.99,1.62	0.061	0.83	0.65,1.06	0.14	0.65	0.49,0.87
40–54	1.40	1.09,1.81	0.009	0.8	0.62,1.03	0.08	0.57	0.42,0.76
55–max	1.72	1.29,2.30	0.001	0.49	0.37,0.66	<0.0001	0.29	0.20,0.40
Education								
Low	1.00	1.00	ref	1.00	1.00	ref	1.00	1.00
Moderate	0.97	0.82,1.14	0.721	0.89	0.75,1.06	0.193	0.92	0.76,1.11
High	1.14	0.92,1.41	0.246	0.64	0.50,0.82	0.001	0.56	0.43,0.73
Household income								
Low	1.00	1.00	ref	1.00	1.00	ref	1.00	1.00
Moderate	1.04	0.86,1.25	0.71	0.85	0.71,1.03	0.098	0.82	0.67,1.02
High	1.05	0.86,1.29	0.626	0.67	0.54,0.82	0.001	0.64	0.50,0.80
No answer	1.11	0.82,1.52	0.498	1.04	0.76,1.41	0.818	0.93	0.66,1.31
Ethnicity								
Non-white, other language	1.00	1.00	ref	1.00	1.00	ref	1.00	1.00
White, English only	0.98	0.78,1.24	0.893	0.93	0.74,1.17	0.546	0.95	0.74,1.22
Employed outside the home								

Parameter	<i>Changes in Number of Smoking Friends Between Wave 1 and Wave 2</i>							
	Event = loss, (vs. no change)				Event = gain, (vs. no change)			
	OR ^a	95% CI ^b	p-value	OR ^a	95% CI ^b	p-value	OR ^a	95% CI ^b
No	1.00	1.00	ref	1.00	1.00	ref	1.00	1.00
Yes	1.21	1.02,1.43	0.025	1.03	0.87,1.22	0.72	0.85	0.71,1.03
Smoking status								
Daily	1.00	1.00	ref ^c	1.00	1.00	ref	1.00	1.00
Weekly/monthly	1.03	0.78,1.36	0.845	1.01	0.75,1.34	0.974	0.98	0.72,1.34
Heaviness of smoking	0.97	0.93,1.03	0.306	0.98	0.93,1.04	0.534	1.01	0.95,1.07
Attempt to quit in past year								
No attempt	1.00	1.00	ref	1.00	1.00	ref	1.00	1.00
Attempt	1.14	0.97,1.34	0.120	1.00	0.84,1.18	0.992	0.88	0.73,1.06
Longest attempt to quit								
Never attempted	1.00	1.00	ref	1.00	1.00	ref	1.00	1.00
<1 week	0.93	0.72,1.21	0.603	1.05	0.81,1.37	0.701	1.13	0.84,1.51
>1 week but < 6 months	0.87	0.69,1.10	0.249	0.96	0.76,1.22	0.753	1.10	0.85,1.43
>6 months	0.99	0.80,1.23	0.909	0.89	0.71,1.11	0.289	0.90	0.70,1.15
Quit intentions (Wave 1)								
No intention	1.00	1.00	ref	1.00	1.00	ref	1.00	1.00
Intention	1.09	0.93,1.29	0.282	1.06	0.89,1.25	0.515	0.97	0.80,1.17
Outcome expectancy of quitting	0.98	0.92,1.05	0.568	1.00	0.93,1.08	0.980	1.02	0.94,1.11
Worried smoking will damage health	1.02	0.94,1.10	0.715	0.91	0.84,0.99	0.029	0.90	0.81,0.99
Number of smoking friends at Wave 1	1.40	1.34,1.47	<0.0001	0.64	0.61,0.67	<0.0001	0.46	0.43,0.48

^aOR=Odds Ratio

^b95% Confidence Interval

^cref=reference group

Table 4
Friend Change Between Wave 1 and Wave 2, plus Wave 2 smoking status, Multivariable Model, (N=6,321)

Parameter	Changes in Number of Smoking Friends Between Wave 1 and Wave 2							
	Event = loss, (vs. no change)				Event = gain, (vs. no change)			
	OR ^a	95% CI ^b	p-value	ref ^c	OR ^a	95% CI ^b	p-value	ref
Smoking status at Wave 2								
Daily	1.00	1.00	ref ^c	ref	1.00	1.00	1.00	ref
Weekly	1.35	0.93,1.96	0.903	0.903	1.31	0.91,1.89	0.143	0.98
Monthly	2.97	1.36,6.48	0.007	0.007	2.53	1.16,5.53	0.020	0.85
Quit less than 1 month	1.57	0.99,2.51	0.057	0.057	0.54	0.31,0.95	0.034	0.34
Quit 1 – 6 months	1.96	1.47,2.63	<0.0001	<0.0001	0.76	0.52,1.10	0.146	0.39
Quit more than 6 months	2.61	1.30,5.23	0.007	0.007	0.86	0.38,1.96	0.726	0.33

^a OR=Odds Ratio
^b 95% Confidence Interval
^c ref=reference group
^d Adjusting for variables in Table 3 (demographic characteristics and smoking cessation predictor variables, and number of smoking friends at Wave 1)

Table 5

Predictors of Number of Smoking Friends at Wave 1 – Multivariable Model, (N=6,321)^a

Parameter	n	Mean # of Smoking Friends ^b	95% CI of Mean ^c	Estimate	Standard Error	95% CI of Estimate ^c	p-value
Household Composition ^d							
Mixed smokers and non-smokers	3062	2.56	2.50,2.63	ref			
Single adult smoker	1637	2.64	2.55,2.73	0.15	0.06	0.03,0.26	0.012
All adult smokers	1622	3.19	3.11,3.27	0.56	0.05	0.45,0.66	p<0.0001

^a unweighted frequencies

^b weighted means

^c CI = Confidence Interval

^d Adjusting for variables in Table 2 (demographic characteristics and smoking cessation predictor variables), plus Wave 2 smoking status

Table 6

Wave 1 Predictors of Friend Change Between Wave 1 and Wave 2, Multivariable Model, (N=6,321)

Parameter	Changes in Number of Smoking Friends Between Wave 1 and Wave 2							
	Event = loss, (vs. no change)				Event = gain, (vs. no change)			
	OR ^a	95% CI ^b	p-value	OR ^a	95% CI ^b	p-value	OR ^a	95% CI ^b
Household Composition ^d								
Smokers and non-smokers	1.00	1.00	ref ^c	1.00	1.00	ref	1.00	1.00
Single adult smoker	0.91	0.76,1.09	0.322	0.95	0.79,1.15	0.616	1.04	0.84,1.29
All adult smokers	0.92	0.78,1.10	0.365	1.32	1.11,1.58	0.002	1.43	1.18,1.74

^aOR=Odds Ratio

^b95% Confidence Interval

^cref=reference group

^d Adjusting for variables in Table 3 (demographic characteristics and smoking cessation predictor variables, and number of smoking friends at Wave 1), plus Wave 2 smoking status