



Nicotine dependence matters: Examining longitudinal association between smoking and physical activity among Canadian adults



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ABSTRACT

Objective. A number of studies point to the inverse relationship between physical activity and smoking; however, none has examined the role of nicotine dependence in physical activity participation among smokers. This study examined whether levels of nicotine dependence modify the association between leisure time physical activity and smoking status.

Methods. The study used longitudinal data on 6795 adults from the Canadian National Population Health Survey (2004–2010). Generalized estimating equations were used to examine the association between physical activity, smoking, and nicotine dependence.

Results. We found that nicotine dependent smokers were significantly less likely to be physically active compared to non-smokers. Specifically, using the Fagerstrom Test for Nicotine Dependence, nicotine dependent smokers (OR 0.65, 95% CI 0.55–0.76) were less likely to be physically active while no significant difference was found for non-dependent smokers (OR 0.90, 95% CI 0.80–1.02) compared to non-smokers.

Conclusions. Nicotine dependence matters in shaping engagement in physical activity among daily smokers. Efforts directed at promoting smoking cessation through nicotine dependence treatment intervention may provide additional benefits to health and well-being through an increased participation in physical activity.

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Introduction

The health benefits of active living are substantial and have been well documented (Haskell et al., 2007; Vogel et al., 2009; Warburton et al., 2006). Relative to inactive individuals, those who regularly engaged in physical activity benefit from a reduced risk of type 2 diabetes, hypertension, depression, cancer, cardiovascular disease, osteoporosis, and premature death (Pate et al., 1995; Warburton et al., 2006). In Canada, the economic burden of physical inactivity through health care related costs and lost productivity due to disability and premature death is profound, with an estimated cost of \$5.3 billion in 2001 (Katzmarzyk and Janssen, 2004). Chenoweth and Leutzinger (2006) estimated the combined economic cost of physical inactivity and excess weight in American adults to be \$507 billion in 2003.

Physical activity is also related to smoking status, with a number of studies pointing to the inverse relationship between physical activity and smoking among adults (Azagba and Sharaf, 2012; Charilaou et al., 2009; Gardner et al., 1999; Kvaavik et al., 2004; Laaksonen et al., 2002; Pitsavos et al., 2005; Strine et al., 2005) and adolescents (Charilaou et al., 2009; Holmen et al., 2002; Nkansah-Amankra et al., 2011; Osler et al., 2001; Pate et al., 1996; Verkooyen et al., 2009; Wilson

et al., 2005). Smokers are less likely to be regularly engaged in physical activity and, as such, are doubly disadvantaged, suffering the direct negative effects of smoking on health, as well as indirect effects due to physical inactivity. Not all studies, however, find an association between smoking and physical activity, with a few studies noting either no association or mixed association (Paulus et al., 2000; Verkooyen et al., 2008; for a comprehensive review of the literature see Kaczynski et al., 2008).

Examinations of the association of smoking with physical activity have typically employed discrete measures of smoking status (e.g., yes/no or daily, non-smoker); no study has yet assessed the role of nicotine dependence among smokers in shaping physical activity. The distinction between smoking status and nicotine dependence is an important one, as not all smokers are nicotine dependent, even after many years of smoking (Horn et al., 2003). The proportion of smokers who report being nicotine dependent varies across studies based on smoking status and the measure of dependence employed (DSM criteria or the Fagerström Test); nicotine dependence ranges from 28.5% of last month adult smokers to 50% of lifetime daily smokers (Breslau et al., 2001; Kandel and Chen, 2000). Nicotine dependent smokers typically smoke more cigarettes, and have a longer smoking history than non-dependent smokers, while they also more likely to report seeking help to stop or reduce their smoking, but are less successful in achieving their smoking cessation goals (Fagerstrom and Furberg, 2008; John et al., 2004; Pinto et al., 1987).

The distinction between nicotine dependent and non-dependent smokers has also shown to be important in assessing the effects of

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smoking on health outcomes and related risk factors (Grant et al., 2004; Hughes, 2011; Pedersen and Von Soest, 2009; Sherwood et al., 2000). In particular, a large body of research points to higher rates of poor mental health outcomes among nicotine dependent smokers (Breslau et al., 1993; Grant et al., 2004; Jamal et al., 2012; Pedersen and Von Soest, 2009). For example, in a prospective study of the association between daily smoking and nicotine dependence, and mental health among Norwegian young adults, Pedersen and Von Soest (2009) found nicotine dependence to be associated with elevated risk of depression. The authors note that using standard measures of daily smoking without accounting for nicotine dependence would have underestimated the association between smoking and mental health. The present study looks to build on this literature by focusing on physical health and well-being through an examination of how nicotine dependence affects the relationship between cigarette smoking and physical activity. More specifically, we look to assess whether nicotine dependent daily smokers and non-dependent smokers are less involved in physical activity than non-smokers.

Methods

Data

Data were drawn from the confidential master file of the National Population Health Survey (NPHS). Briefly, the NPHS is a nationally representative longitudinal survey of the Canadian population and based on a multistage stratified random sampling design. The survey started in 1994 and undertook a follow-up of the same individuals every two years thereafter. The NPHS excludes people living on Indian Reserves and Crown Lands, full-time members of the Canadian Armed Forces and some remote areas of Ontario and Quebec. The data set contains a large number of variables related to health, as well as corresponding economic and socio-demographic variables. Four waves of the NPHS, 2004, 2006, 2008 and 2010 were used in this study since the main variable of interest, nicotine dependence is only available from 2004 onward. The analysis was restricted to those aged 18–60 years, resulting in a study sample of 6795 individuals. Older adults were excluded from the analysis as physical activity participation among seniors was relatively small and the presence of other health related issues may complicate the analysis.

Outcome measure: Physical activity

Physical activity was assessed from respondents answering questions related to frequency, duration per session and intensity of 20 leisure activities (e.g., walking for exercise, bicycling, swimming, ice skating, jogging or running) they participated in the three months prior to the interview. The average daily energy expenditure for each leisure-time physical activity is then measured by multiplying the frequency of participating in the activity, duration per session and the metabolic equivalent of the task (MET). The MET measures the energy cost (kilocalories per kilogram of body weight per hour) and its values are normally expressed in three intensity levels: low, medium and high. MET is calculated using the low intensity value of each activity, since individuals may overestimate the intensity, frequency and duration of their activities. An individual is classified as physically active if the average daily energy expenditure is 3 or more kilocalories per kilogram of body weight per day, as moderately active if the total daily energy expenditure is greater than 1.5 and less than 3 kcal per kilogram of body weight per day and otherwise inactive. The three physical activity groups (active, moderately active and inactive) are combined into physically active (representing average daily energy expenditure ≥ 1.5 kcal/kg) vs. physically inactive (average daily energy expenditure < 1.5 kcal/kg).

Independent variables

Nicotine dependence was measured using the Fagerstrom Test for Nicotine Dependence (FTND), a revised version of the Fagerstrom Tolerance Questionnaire (Heatherton et al., 1991). Previous research has shown reasonable reliability and internal consistency of the FTND (Pomerleau et al., 1994; Salameh et al., 2013). Daily smokers were asked the following six questions: “How soon after you wake up do you smoke your first cigarette (within 5 min, within 6 to 30 min, within 31 to 60 min, after 60 min; coded 3 to 0)?”, “Do you find it

difficult to refrain from smoking in places where it is forbidden (yes = 1, no = 0)?”, “Which cigarette would you most hate to give up (the first one of the day = 1, another one = 0)?” “Do you smoke more frequently during the first hours after waking, compared with the rest of the day (yes = 1, no = 1)?”, “Do you smoke even if you are so ill that you are in bed most of the day (yes = 1, no = 1)?”, and “How many cigarettes do you smoke each day now (31 or more, 21 to 30, 11 to 20, 10 or less, coded 3 to 0)?”. The FTND score (range, 0 to 10) was grouped into five categories: 1–2 = very low dependence; 3–4 = low dependence; 5 = medium dependence; 6–7 = high dependence; and 8–10 = very high dependence (Fagerstrom et al., 1991). In our study, we dichotomized the FTND score at a cut point of more than 4 to indicate nicotine dependent smokers (Pedersen and Von Soest, 2009). In addition to the FTND, we used time to first cigarette after waking up (TTFC) as a separate nicotine dependence measure. TTFC has previously been used as a measure of nicotine dependence and has been shown to have strong predictive validity (Baker et al., 2007), and to highly correlate with cotinine levels among regular smokers (Branstetter and Muscat, 2012; Muscat et al., 2009). We dichotomized TTFC at a cut point of 30 min or less to indicate high nicotine dependence (Gilpin et al., 1999; Muscat et al., 2009). Employing these two measures of nicotine dependent leaves us with three distinct groups – non-smokers, non-nicotine dependent smokers, and nicotine dependent smokers.

The analyses also adjusted for other variables that have been shown to be associated with physical activity (Seefeldt et al., 2002; Bruce and Katzmarzyk, 2002; Caperchione et al., 2009; Perez, 2002): age; marital status (married, separated, and single, reference category); educational attainment (post-secondary, some post-secondary, secondary and less secondary, reference category); immigration status (Canadian born vs. immigrant); number of chronic conditions diagnosed by a health professional (e.g., bronchitis or emphysema, asthma, epilepsy, migraine headaches, stroke, fibromyalgia); physical limitations; household composition; income level (high income, middle income and low income, reference category); trend; and province of residence.

Statistical analyses

To examine associations between physical activity, smoking, and nicotine dependence, a generalized estimating equation with a logit link and exchangeable correlation structure was used (Liang and Zeger, 1986). We performed a baseline estimation examining the association between smoking status (daily smoker = 1) and physical activity. We then completed stratified analyses using two measures of nicotine dependence, the FTND and the TTFC to examine if the relationship between smoking and physical activity varies across levels of nicotine dependence. In addition, analysis was stratified by gender, adjusting for age, education, income, marital status, immigration status number of chronic conditions, physical limitations, trend and province of residence to the analysis. Analyses were conducted using Stata 11.

Results

The summary characteristics of the study population at baseline (2004) are reported in Table 1. Respondents were averaged 40 years of age, most had attained at least some post-secondary education (76%), and the majority was born in Canada (85%). Approximately 52% were physically active and 21% were daily smokers. About 8% were nicotine dependent and 13% were non-dependent based on FTND.

The adjusted odd ratios for the association between smoking and physical activity using the baseline specification are reported in Table 2. To determine if the association between physical activity and smoking was sensitive to time and province fixed effects, we estimated the full model that included all covariates and estimated another model without time trend and province of residence. Results from both models were quantitatively similar and only the full model results are reported. The results showed that smoking is inversely related to physical activity after adjusting for potential confounders and secular trend. Specifically, being a daily smoker (odds ratio [OR] 0.80, 95% confidence interval [CI] 0.72–0.89,) was significantly associated with a lower odds of physical activity compared to non-smokers. The results examining the association of nicotine dependence and physical activity using the FTND are reported in Table 3. We found that nicotine dependent smokers were significantly less likely to be physically active compared to non-

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