



## The period prevalence of risk behavior co-occurrence among Canadians



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### ABSTRACT

**Introduction.** While the benefits of complying with health recommendations is well documented, a considerable proportion of Canadians engage in multiple modifiable risk behaviors. The purpose of this multi-wave longitudinal study was to identify the individual period prevalence and co-occurrence of multiple modifiable risk behaviors, particularly excessive alcohol consumption, physical inactivity, and tobacco use, within a nationally representative sample of Canadians.

**Methods.** Secondary data analysis was conducted on the first seven cycles of the National Population Health Survey. This longitudinal sample included 15,167 Canadians aged 12 years of age or older. Gender-specific criteria were employed to define excessive alcohol consumption. Individuals expending <3.0 kcal/kg/day during their leisure-time and smoking cigarettes (daily or occasionally) met the criteria for physical inactivity and tobacco use, respectively.

**Results.** The period prevalence of the Canadian general population that participated in multiple risk behaviors was 21.5% in cycle 7. The most common pairwise combination of co-occurring risk behaviors was physical inactivity and smoking. The proportion of Canadians reporting the co-occurrence of all three risk behaviors in cycle 7 was 2.6%.

**Conclusions.** Understanding patterns of modifiable risk behaviors is an initial step in developing and implementing public health interventions. The co-occurrence of these three risk behaviors is a viable concern for one in five Canadians. For these individuals, the likelihood of encountering premature morbidity and mortality is escalated. As the majority of Canadians reported being physically inactive, allocating limited resources towards enhancing leisure-time physical activity levels could have significant population-level implications for improving the health of Canadians.

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### Introduction

A generally accepted tenet of public health stipulates that reductions in the prevalence of health risk behaviors are associated with reductions in premature morbidity and mortality, a higher active life expectancy and an enhancement in quality of life (Ferrucci et al., 1999; Knuops et al., 2004). Unlike genetics or aging, positive changes to modifiable risk behaviors including alcohol consumption, physical activity levels, and smoking can significantly reduce the odds of developing chronic and/or debilitating diseases (Kvaavik et al., 2010).

While the benefits of participating in healthy lifestyles are widely known, convincing the population to adhere to such behavioral

recommendations continues to be challenging. For many Canadians, excessive alcohol consumption, physical inactivity, and smoking are part of their daily routine (Leatherdale and Rynard, 2013; Klein-Geltink et al., 2006; Makrides et al., 2010; Li et al., 2009; Alaman and Paradis, 2009; Deering et al., 2009). Even more problematic is the fact that these unhealthy behaviors have a tendency to co-occur as 39% to 93% of Canadians possess multiple risk behaviors in cross-sectional research (Leatherdale and Rynard, 2013). This accumulation of risk behaviors can pose a negative synergistic effect on the health of individuals (Meng et al., 1999).

Although the co-occurrence of multiple risk behaviors is beginning to gain additional attention in the public health literature (McAloney et al., 2013), longitudinal research regarding the co-occurrence of risk behaviors is limited. Previous cross-sectional studies have been unable to account for longitudinal changes in the co-occurrence of risk behaviors (Klein-Geltink et al., 2006). Evaluating longitudinal trends in multiple risk behaviors will provide health professionals and policymakers

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with the necessary guidance to develop and implement effective public health interventions in Canada (Li et al., 2009). Consequently, the purpose of this analysis was to evaluate the period prevalence of co-occurring risk behaviors longitudinally, specifically excessive alcohol consumption, leisure-time physical inactivity, and tobacco use, within a nationally representative sample of Canadians across multiple time intervals.

## Methods

The study design of the longitudinal National Population Health Survey (NPHS) is described elsewhere (Statistics Canada, 2008). In 1994/1995, the first cycle of data collection began. Subsequent cycles of data collection have occurred biennially. Currently there are 9 available cycles of data collection in the NPHS. However, at the time in which this analysis was conducted, only 7 cycles of data were available. It is the first seven cycles that were the focus of the current statistical analysis (Statistics Canada, 2008).

The target population of the NPHS included individuals residing throughout all 10 provinces in Canada. Excluded from the NPHS sampling frame were individuals residing on Indian Reserves and Crown Lands, institutions, or isolated areas in Ontario and Quebec, as well as full-time members of the Canadian Forces Bases (Statistics Canada, 2008). In addition, questions pertaining to alcohol consumption, leisure-time physical activity energy expenditure, and smoking were not asked of Canadians under the age of 12 years. Consequently, Canadians less than 12 years of age at baseline were excluded from this analysis. At baseline, this sample consisted of 15,167 Canadians that were 12 years of age or older. It is these individuals that were the focus of this longitudinal analysis. The attrition rate at the seventh cycle for this sample of Canadians was approximately 35%.

At each data collection cycle, Canadians were assigned a response status of either completed, deceased, institutionalized, partial response, or non-response. Those individuals who completed the seventh cycle of the NPHS were compared to individuals who received a response status of deceased, institutionalized, partial response, or non-response. An increased likelihood of completing the final cycle was significantly associated with a younger age, being married or formerly married, advanced education, higher income adequacy, and a greater BMI score at the first cycle. In regards to behavioral characteristics, leisure-time physical activity energy expenditure did not distinguish between participation in the NPHS at the final follow-up. However, that was not the case for smoking and alcohol consumption. Individuals consuming greater quantities of alcoholic beverages and smoking fewer cigarettes, including abstinence, were significantly more likely to participate in the seventh cycle of the NPHS.

The current statistical analysis evaluated the period prevalence of excessive alcohol consumption, leisure-time physical inactivity, and tobacco use. These three modifiable risk behaviors were chosen for this statistical analysis as they are among the most prevalent within the Canadian general population (Klein-Geltink et al., 2006; Li et al., 2009) and have previously demonstrated significant co-variation (deRuiter et al., 2014).

Alcohol consumption was assessed by the respondent's weekly alcohol consumption. Weekly alcohol consumption was calculated by the summation of the total number of alcohol beverages consumed during the previous week (Statistics Canada, 2008). This variable was calculated for individuals who had consumed at least one alcoholic beverage within the previous 12 months (Statistics Canada, 2008). For this analysis, individuals who had not consumed an alcoholic beverage in the previous 12 months received a weekly alcohol consumption value of 0. Gender-specific criteria were employed to define excessive alcohol consumption. Males and females who drank a minimum of 15 and 10 alcoholic drinks per week, respectively, were identified as consuming unhealthy quantities of alcohol. These cut-offs coincide with guidelines pertaining to low-risk drinking (Bondy et al., 1999; Wilkins, 2002).

Leisure-time physical activity was measured by an individual's average daily leisure-time energy expenditure. For each type of leisure-time physical activity, energy expenditure was calculated by estimating the average duration of activity in hours, the frequency of participation over the previous year, as well as the metabolic equivalent value represented as kilocalories (kcal) expended per kilogram (kg) per hour (Statistics Canada, 2008). The product of the duration, frequency, and metabolic equivalent of each mode of leisure-time physical activity was divided by 365 to acquire the daily energy expenditure (Statistics Canada, 2008). Overall daily energy expenditure was calculated by the summation of daily energy expenditure for each mode of leisure-time physical activity

(Statistics Canada, 2008). Individuals expending a minimum of 3.0 kcal/kg/day of energy during leisure-time activities met the recommended guidelines for physical activity (Katzmarzyk and Tremblay, 2007; Haskell et al., 1985). A similar cut-off has been used by others to define an active lifestyle (Da Costa et al., 2003; deRuiter et al., 2008; Gauthier et al., 2012). Consequently, those individuals who were unable to fulfill this criterion were considered physically inactive.

Canadians were identified as smokers if they currently smoked cigarettes either daily or occasionally. This definition has been used in previous research (deRuiter et al., 2014; Wong et al., 2012). Those individuals who identified their smoking status as "not at all" were considered non-smokers.

## Statistical analyses

Univariate analyses were performed on individual characteristics consisting of gender (male and female), chronological age (in years), marital status (married/common-law, single, formerly married), education (less than secondary school, secondary school graduation, some post-secondary schooling, and post-secondary graduation), income adequacy (lowest income, lower middle income, upper middle income, highest income, and missing income), and body mass index (BMI). Formerly married referred to individuals who were widowed, separated, or divorced (Statistics Canada, 2008). Education was based upon the highest level of education attained by the respondent, while income adequacy was classified in accordance to the total household income adjusted for the number of individuals residing in the household (Statistics Canada, 2008).

Using the aforementioned health recommendations, the period prevalence rates of excessive alcohol consumption, leisure-time physical inactivity, and smoking were calculated at each of the seven cycles of data collection. For each cycle of data collection, these three risk behaviors were used independently as well as in conjunction to assess the percentage of Canadians who participated in the following unhealthy behaviors: 1) no risk behaviors, 2) exclusively excessive alcohol consumption, 3) exclusively leisure-time physical inactivity, 4) exclusively smoking, 5) excessive alcohol consumption and leisure-time physical inactivity, 6) leisure-time physical inactivity and smoking, 7) excessive alcohol consumption and smoking, as well as 8) excessive alcohol consumption, leisure-time physical inactivity, and smoking. These period prevalence rates were calculated using Statistical Package for the Social Sciences (SPSS Software, 2009). Confidence intervals (CI) were calculated by using bootstrapping weights. Longitudinal sampling weights developed by Statistics Canada were utilized for this statistical analysis (Statistics Canada, 2008). Furthermore, the complexity of the survey sampling was accounted for by the use of bootstrapping weights (Statistics Canada, 2008). Due to the substantial sample size of the NPHS, the level of significance for this research study was established at 0.01. This study received ethics approval from the Social Sciences and Humanities Research Council of Canada as well as the University of Toronto.

## Results

Weighted demographic characteristics for this sample are presented in Table 1. In 1994/1995, females represented 51.0% of this Canadian sample. The age of this sample increased from 41 years at baseline to 51 years at the seventh cycle. The majority of Canadians, 58.9%, were married or in a common-law relationship at the first assessment period. By 2006/2007, this proportion increased to 66.5%. Individuals appeared to have attained higher levels of education and income adequacy over the seven cycles of the NPHS.

Table 2 examines the period prevalence of risk behaviors at each cycle of data collection. The calculated period prevalence rates indicate the percentage of this Canadian sample who practiced a particular risk behavior regardless of whether any additional behaviors may or may not have been present. The proportion of this Canadian sample who were physically inactive, <3.0 kcal/kg/day, significantly decreased from 80.4% (99% CI: 79.2–81.5%) in 1994/1995 to 73.5% (99% CI: 71.8–75.2%) in 2006/2007. Tobacco use demonstrated a similar favorable trend between 1994/1995 and 2006/2007. During the first four cycles of data collection, the percentage of daily and occasional smokers in this Canadian sample decreased by only 2.5%; from 29.3% (99% CI: 28.2–30.5%) to 26.8% (99% CI: 25.4–28.1%). However, by the seventh cycle, smokers represented only 21.3% (99% CI: 19.8–22.8%) of the current sample; a difference of 8.0% from the initial data collection period.

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