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Multimorbidity in Atlantic Canada and association with low levels of physical activity

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ABSTRACT

Owing to an aging population and medical advances, the anticipated growth and prevalence of multimorbidity has been recognized as a significant challenge and priority in health care settings. Although physical activity has been shown to play a vital role in the primary and secondary prevention of chronic disease, much less is known about the relationship between physical activity and multimorbidity. The objective of the present study was to examine the relationship between physical activity levels and multimorbidity in male and female adults after adjusting for key demographic, geographical, and lifestyle factors. The study drew data from a prospective cohort in Atlantic Canada (2009–2015). The sample included 18,709 participants between the ages of 35–69. Eighteen chronic diseases were identified. Physical activity levels were estimated based on the long form of the International Physical Activity Questionnaire. Using logistic regression analysis, we found that multimorbid individuals were significantly more likely to be physically inactive (OR = 1.26; 95% CI 1.10, 1.44) after adjusting for key sociodemographic and lifestyle characteristics. Additional stratified analyses suggest that the magnitude of the effect between multimorbidity and physical activity was stronger for men (OR = 1.41; 95% CI 1.12, 1.79) than women (OR = 1.18; CI 1.00, 1.39) and those living in rural (OR = 1.43; CI 1.10, 1.85) versus urban (OR = 1.20; CI 1.02, 141) areas. Given the generally low levels of physical activity across populations and a growing prevalence of multimorbidity, there is a need for a prospective study to explore causal associations between physical activity, multimorbidity, and health outcomes.

1. Introduction

In 2013, five chronic diseases (malignant neoplasms, heart disease, cerebrovascular disease, chronic respiratory disease, and diabetes mellitus) accounted for 62% of all deaths in Canada (Statistics Canada, 2017). According to the World Health Organization (World Health Organization, 2015), physical inactivity is the fourth leading risk factor for global mortality and has been estimated to contribute to as much as 21–25% of breast and colon cancer, 27% of diabetes, and 30% of ischemic heart disease burden worldwide. Owing to an aging population, improved detection, medical treatments, health care utilization, and changing lifestyles, more individuals are being diagnosed and are living longer with a chronic condition. Consequently, the prevalence of multimorbidity or the co-occurrence of two or more chronic diseases; (van den Akker et al., 1996) is a common and rapidly growing health care concern (van Oostrom et al., 2016). While estimates vary, the prevalence of multimorbidity is on the rise and a growing body of literature has demonstrated the multiple negative consequences of living with coexisting multiple chronic diseases (Pefoyo et al., 2015; van Oostrom et al., 2016). Multimorbidity has been associated with unhealthy lifestyles and can result in lower quality of life, higher health care and medication utilization, and mortality (Fortin et al., 2014; Pefoyo et al., 2015).

Physical activity has been shown to prevent the onset of > 25 chronic diseases and to improve the general health of individuals living with such conditions (Pedersen and Saltin, 2015; Rhodes et al., 2017; Warburton et al., 2006; Warburton and Bredin, 2016). A clear dose-response relationship has also been demonstrated showing that in comparison to sedentary individuals, more active individuals have lower chronic disease risk (Rhodes et al., 2017; Warburton et al., 2006). Specifically, all-cause mortality risk in highly active individuals is as much as 29% lower than in sedentary individuals (Samitz et al., 2011). Of note, while participation in the minimum recommended levels of physical activity (150 min/week of moderate-intensity physical

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activity) has shown a 19% reduction in all-cause mortality (Woodcock et al., 2011), recent studies have revealed that relatively small volumes of physical activity (i.e., less than half of the recommended 150 min/week of moderate-to-vigorous intensity physical activity) can significantly reduce the risk of chronic disease and all-cause mortality (Rhodes et al., 2017). Importantly, physical activity has also been shown to reduce disease-specific mortality, highlighting the significant therapeutic benefits of physical activity in clinical populations (Anderson and Taylor, 2014; Harber et al., 2017; Heiwe and Jacobson, 2014; Li et al., 2016; McCarthy et al., 2015; Sagar et al., 2015).

Despite an increased understanding of the importance of physical activity in both the primary and secondary prevention of chronic disease, the impact of multimorbidity on physical activity levels has not been well-described. Further, while a growing body of literature has described the burden of multimorbidity in older adults (Dhalwani et al., 2016; van Oostrom et al., 2016), the impact of multimorbidity on physical activity levels in non-geriatric adults (≤ 65 years) has yielded limited and dissenting results (Hudon et al., 2008; Vancampfort et al., 2017). As a region with one of the poorest health profiles in Canada (Public Health Agency of Canada, 2011), the purpose of the present study was to examine the cumulative impact and relationship between multimorbidity and physical activity levels in a regional cohort of Atlantic Canadians aged 35–69 years. Moreover, as multimorbidty has been shown to be higher in women (Roberts et al., 2015) and appear to be influenced by urban/rural status (O'Connor and Wellenius, 2012), we also sought to explore whether sex or rurality modified the relationship between multimorbidity and physical activity.

2. Methods

2.1. Study design and population

This cross-sectional study drew participant data from the Atlantic Partnership for Tomorrow's Health (PATH) study. Atlantic PATH is part of the Canadian Partnership for Tomorrow Project, a national prospective cohort study examining the influence of genetic, environmental, and lifestyle factors in the development of cancer and chronic disease (Borugian et al., 2010; Sweeney et al., 2017). The study protocol was approved by the appropriate provincial and regional ethics boards and all participants provided written informed consent prior to participation. Participants were recruited from 2009 to 2015 in Nova Scotia, New Brunswick, Prince Edward Island, and Newfoundland and Labrador, Canada and will be followed over a period of 30 years. A detailed cohort profile is presented elsewhere (Sweeney et al., 2017). The current analysis includes 18,709 participants aged 35–69 years who provided information on physical activity, presence/absence of chronic disease, and sociodemographic and lifestyle characteristics.

2.2. Physical activity

Participants were asked to report their levels of physical activity using open-ended questions in the International Physical Activity Questionnaire (IPAQ) long form (Craig et al., 2003). The IPAQ asks participants to identify the frequency and duration of all vigorous, moderate, and walking physical activity (i.e., inclusive of occupational, transportation, domestic and leisure-time) within the last seven days. Participants were asked only to report activities that were in bouts of 10 min or more. Each question defined the specific intensity and domain and provided examples. Using the IPAQ guidelines for data processing and analyses, daily and weekly metabolic equivalents of a task (MET) values were calculated for each domain. Total physical activity scores in MET minutes/week were calculated by summing MET values cross all domains. In accordance with the criteria of IPAQ scoring protocol (https://sites.google.com/site/theipaq/scoring-protocol), categorical physical activity scores were defined as inactive/not meeting guidelines (< 600 MET min/week), moderately active/meeting guidelines (600–1500 MET min/week), and active/meeting guidelines (> 1500 MET minutes/week or accumulating at least 3000 MET-min/week through a combination of walking, moderate- or vigorous-intensity activities) (Tremblay et al., 2011).

2.3. Chronic disease and multimorbidity

Atlantic PATH participants completed a medical history questionnaire that included information about a participants self-reported history of one or more of the following 18 chronic diseases: cancer (excluding skin cancer), asthma, chronic obstructive pulmonary disease, chronic bronchitis, emphysema, liver cirrhosis, chronic hepatitis, myocardial infarction, stroke, hypertension, type I and II diabetes, bowel disease (irritable bowel disease and irritable bowel syndrome), dermatologic disease (psoriasis and eczema), multiple sclerosis, arthritis, systemic lupus erythematosus, osteoporosis, and obesity (BMI ≥ 30 kg/m^2) (Kyle et al., 2016; Puhl and Liu, 2015; Via and Mechanick, 2014; Warburton and Bredin, 2016). The prevalence of self-reported chronic disease was dichotomized as yes/no based on participant response and the number of chronic conditions for each participant were summed. BMI was calculated by dividing weight in kilograms by height in meters squared. Measured weight and height data from assessment clinics was used when available and when unavailable self-reported weight and height were used. Multimorbidity was defined as having two or more chronic diseases and participants were classified into three groups according to the number of chronic conditions that they reported (none, one, and two or more).

2.4. Socio-demographic and lifestyle

Self-reported sex, age, education, urban or rural residence (rurality), working status, marital status, household income, alcohol consumption, smoking status, and BMI were included as covariables in the analysis to account for potential variance in physical activity levels. As rates of multimorbidity have been shown to differ by sex and rurality these variables were also included in stratified analyses.

2.5. Statistical analyses

Statistical analyses were performed using SAS 9.4 for Windows (SAS, Carey, NC). All descriptive statistics are presented as frequencies and percentages for categorical variables, and as means and standard deviations for continuous variables. The binary response for physical inactivity was defined using total physical activity scores < 600 MET min/week. The overall risks (ORs with 95% confidence intervals) for physical inactivity at different levels of chronic disease (0 - reference, 1, or 2 or more) were compared using univariate and multivariable logistic regression analysis. Models were adjusted for sociodemographic and lifestyle characteristics including sex, age, education, working status, marital status, household income, smoking status, alcohol assumption, BMI, province, and rurality where appropriate. Analyses were conducted for overall, and were stratified by sex and by rurality. Statistical significance was accepted for p values < 0.05 (two-sided).

3. Results

Tables 1 and 2 present the characteristics of the study sample. Of 18,709 participants, 70% were women and 71% reported residing in an urban area. Twelve percent of men and 11% of women were classified as physically inactive. Obesity was the most frequently reported chronic condition among both males (30.4%) and females (29.0%), followed by hypertension (males: 28.4%; females: 22.9%), and arthritis (males: 19.5%; females: 26.6%) (Table A1). Overall, 31.9% of males reported no chronic health conditions, compared to 28.3% of women. Thirty-eight percent of the participants reported having at least two chronic