Examining Chronic Disease, Pain-Related Impairment, and Physical Activity Among Middle-Aged and Older Adults in Canada: Implications for Current and Future Aging Populations

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Abstract

Purpose: With high levels of chronic disease (CD) and pain-related functional impairment (PFI), and low levels of physical activity (PA) among middle-aged and older adults, it is important to investigate ways to design age- and health condition-appropriate PA interventions.

Methods: Using Canadian Community Health Survey data, relationships among CD, PFI, covariates, and PA were examined in mid- (40-59y; n=36,288) and later- (60y+, n=44,890) life.

Results/Conclusions: PA levels varied between middle-aged and older groups according to CD and PFI status. Results are useful for developing targeted and tailored PA interventions to support the health of current and future populations.

Keywords: Aging; Chronic Diseases; Pain Management; Exercise; Population Dynamics; Cohort Studies; Health Promotion.

Introduction

Context

The proportion of middle-aged and older adults in the world is increasing steadily and this growth will continue.[1,2] Life expectancy is also increasing and the combination of this longevity paired with the growing aging demographic has generated great interest in the "greying" of the global population.[3] The concept of healthy aging has garnered particular attention due to the considerable evidence that connects prevalent negative health-related conditions to the aging process (e.g., chronic disease, pain, functional impairment, and disability). Therefore, greater numbers of middle-aged and older adults are living longer, but not necessarily better or healthier lives.[4] As a result, focusing on the factors that relate to health with aging is important and timely. Research examining ways to promote healthy aging allows health professionals, practitioners, and policy makers to strategize ways to prevent negative health-related outcomes among aging individuals, or at least mitigate the harmful impact of these conditions. Focusing on the modifiable factors that contribute to healthy aging—such as physical activity—is particularly beneficial, so that current and future cohorts of middle-aged and older adults can all benefit from healthy aging promotion strategies.[5] These strategies are especially relevant to rapidly aging populations, such as Canada.

Current Issues

Significant reported challenges associated with an aging population include growing rates of chronic disease, pain, functional impairment, and disability. For instance, the Public Health Agency of Canada reported that approximately 40% of the population aged 45 to 64 reports having no chronic disease, compared to only 8% for those aged 80 and greater.[6] Therefore, about nine in ten older adults will have at least one chronic condition.[6] One of the most widespread

chronic conditions within an aging population is osteoarthritis, which is reported by about 85% of individuals over the age of 75 in Canada. Other prevalent chronic diseases among middle-aged and older adults include cardiovascular disease, stroke, and diabetes.[7-9] Middle-aged and older adults are more likely to have a chronic disease than younger adults, and they are also at a greater risk for developing multiple chronic conditions.

Physical disability, and commonly associated experiences of pain and functional impairment, represent other significant concerns of an aging population. Similar to chronic disease, these conditions are also disproportionately more prevalent later in life, as the likelihood of acquiring these conditions increase with age.[6,9-13] Pain and pain-related functional impairment combined serve as the primary reason why the aging demographic visit a general health practitioner.[14] These conditions are associated with higher levels of stress and depression, as well as lower levels of social support, life satisfaction, and overall quality of life.[14,15] Therefore, research that aims to understand these negative health-related conditions in a health behavior and health promotion context within an aging population is valuable, as such results could be used to improve health outcomes among middle-aged and older adults.

Solution

Fortunately, many of the prevalent negative states of health that are associated with aging are not in fact caused by aging.[16] Rather, many conditions found within an aging demographic are caused by other determinants, such as the lack of regular physical activity. More specifically, participation in physical activity provides a range of biological, psychological, and social health benefits for people of all ages; but, especially those in later life.[8,17] Research shows that those who engage in greater and regular amounts of moderate- to vigorous-intensity physical activity experience better overall health-related quality of life, while those who are inactive have poorer

states of health than their active peers.[5,18] In fact, even low-intensity physical activity is shown to have beneficial health outcomes later in life.[18]

Not only does physical activity promote health, it also prevents the onset of a number of chronic diseases and/or slows the progression of these conditions (e.g., heart disease, obesity, mood disorders).[19-21] As well, those who engage in higher levels of physical activity are less likely to have functional impairments, particularly over the age of 85.[22] As a result, physical activity can be seen as a cost-effective and modifiable mechanism to manage and/or prevent chronic disease and pain-related functional impairment. In turn, this strategy would mitigate health and social care expenditures associated with these conditions, which are the most prevalent in the aging population.[23] Even so, currently, the lowest levels of physical activity are observed among middle-aged and especially older adults. Participation rates tend to decrease as people age and the typical life course of the Canadian population shows a steady decline in physical activity levels over time.[24-26] Further research is needed to generate new and useful knowledge on how to address these low physical activity levels in mid- and later-life, especially among groups of aging adults who could benefit from increased physical activity participation the most—those with chronic disease and pain-related functional impairment.

Age Cohort Comparisons

In terms of physical activity, chronic disease, and pain-related functional impairment, there are a lack of studies that compare middle-aged and older adult cohorts directly. The extant research primarily examines chronic conditions and pain-related functional impairment by combining middle-aged and older adults into one cohort or by including participants of only one age cohort.[27] However, the studies that do make direct comparisons show important cohort-specific differences regarding chronic disease and pain-related functional impairment prevalence,

as well as physical activity patterns. For example, a large population-based Norwegian study examined experiences of chronic pain among middle-aged (40-59 years) and older (60-81 years) adults and found that older adults reported significantly higher severity levels of chronic diseases than middle-aged adults, including diseases associated with chronic pain (i.e., rheumatoid arthritis, osteoarthritis, and osteoporosis).[28]

Another study examined chronic disease combinations and their collective associations with physical activity among adults 45 years of age and greater. Including age as a categorical covariate, it was revealed that older adults (65+ years) were more likely than their relatively younger peers (45-64 years) to have comorbidities that affected their cardiovascular, endocrine, and musculoskeletal systems that, in turn, associated with significantly lower levels physical activity.[29] Given the heterogeneity of an aging population, there is a need for demographic and age cohort specific research on these healthy aging-related factors. Age cohort trends provide even deeper insight on physical activity rates and how future interventions can be developed and designed to meet the needs, experiences, and health-related conditions of particular age groups.[8] Significant age cohort differences have important implications for the promotion of physical activity and healthy aging, as intervention impact and effectiveness would benefit these age groups differently.[30]

Research Problem and Study Purpose

It is clear that participating in physical activity is essential for overall healthy aging. Not only does it support and maintain better health and well-being, it also prevents the onset and/or impact of chronic disease and pain-related functional impairment with age.[14,17,24,31,32] Although these findings are very important for building the rationale for wide-spread support of physical activity in an aging population, less is known about physical activity patterns among middle-

aged and older adults who experience chronic disease, pain-related functional impairment. There is also a paucity of research evidence on ways to develop, target, and tailor effective physical activity promotion strategies or interventions specifically to middle-aged and/or older adults that increase low levels of physical activity. Therefore, age cohort-specific evidence on physical activity participation in mid- and later-life would help inform physical activity programs and policy interventions for those with chronic disease and pain-related functional impairment. Therefore, the purpose of this study was to examine whether the associations between chronic disease, pain-related functional impairment, and physical activity vary in middle-aged and older adults in Canada.

Methods

Study Design and Participant Details

This study used secondary data from the 2013 wave of the Canadian Community Health Survey (CCHS). The CCHS is an ongoing survey that collects cross-sectional, nationally-representative data from individuals over 12 years of age in Canada. Participants were randomly sampled from one of 110 health regions from all Canadian provinces and territories. Participants were identified through households that were selected using three sampling strategies: a geographic area frame, a phone number list frame, and a random digit dialing frame. The geographic area frame used clusters from the Labour Force Survey to select samples of homes within each health region. The phone number list frame contained numbers that were stratified by health region and then randomly sampled. The random digit dialing frame generated phone numbers between 00 and 99 randomly from a phone number bank. Once houses and phone numbers were selected and contacted, participants under the age of 12 were excluded, and remaining individuals in the household were chosen by population-based selection probabilities.

Interviews were conducted over the phone using computer-assisted technology. No incentives were offered to participants. For this study, the sample was limited to adults 40 years of age and older (n=81,178) to capture the target the middle aged (40-59 years, n=36,288) and older age (60+ years, n=44,890) groups under examination.

Measures

The CCHS includes a wide range of variables. Information is surveyed on topics relating to disease and heath conditions; health, lifestyle, and social conditions; and the prevention and detection of diseases. From the larger data set, variables were selected out to best represent the key measures of interest detailed below.

Chronic Disease. As a derived variable found in the CCHS, chronic disease was measured by presence or absence of the following chronic conditions as diagnosed by a health care practitioner: arthritis; asthma; back problems; bowel disorder; cancer; chronic bronchitis, emphysema, or COPD; diabetes; heart disease; high blood pressure; migraine headaches; mood or anxiety disorders; stomach or intestinal ulcers; stroke; and urinary incontinence. Participants who responded yes to any of these chronic conditions were classified as having a chronic disease, while those who responded no were classified as not having chronic disease. Although this measure represents a wide range of diverse chronic conditions, this dichotomous classification has provided valid and reliable results in studies using previous waves of the CCHS data.[17,31]

Pain-Related Functional Impairment. Another CCHS derived variable is the 'Pain Function Code,' which classifies pain in terms of the extent to which it creates functional impairment disability. This measure includes the following five response categories: no experience of pain; experiences of pain that does not prevent activities; experiences of pain that

prevents a few activities; experiences of pain that prevents some activities; and experiences of pain that prevents most activities.

Physical Activity. The CCHS 'Physical Activity Index' categorizes participants into the following three groups: active; moderately active; or inactive. These derived classifications were calculated by multiplying the number of times participants engaged in specified physical activities (e.g., walking for exercise, gardening or yard work, home exercises, jogging or running, swimming, bicycling, exercise class or aerobics, weight-training, etc.) by the specified average duration of the activities. Then the projected amount of kilocalories expended per kilogram of body weight per day (kkd) were calculated, and then these values were classified into active (>3.0 kkd), moderately active (1.5-3.0 kkd), and inactive (<1.5 kkd) groups. On average, those classified as active engaged in the equivalent of more than one hour of daily physical activity; those who were moderately active engaged in approximately 30-59 minutes of daily physical activity; and those who were inactive engaged in less than thirty minutes of daily physical activity. Given the research purpose that aims to explore factors associated with physical activity, the Physical Activity Index measure was transformed into a dichotomous variable. Moderately active and active participants were combined into one group, while inactive participants remained as found in the dataset. Research supports this dichotomy as any amount of physical activity, even at low to moderate levels, is shown to have health-related outcomes (Aoyagi & Shephard, 2010). For this study, the inactive group was compared to the relatively more active group.

Covariates. Other factors included in this study included sex, ethnicity, relationship status, total household income, highest level of education, self-perceived health, and body mass index (BMI). These covariates were selected based on previous research on physical activity and

healthy aging.[5,17,31,33] Each covariate was measured according to the CCHS dataset. Sex was either male or female; ethnicity was either White or visible minority; and relationship status included those who were: married; common law; widowed, separated, and divorced; or single or never married. Total household income responses were: <$20,000; $20,000-$39,999; $40,000-$59,999; $60,000-$79,999; or $80,000+ and highest level of education attained responses were: less than secondary school; secondary school; some post-secondary; or post-secondary. Self-perceived health categories were: excellent; very good; good; fair; or poor. BMI classifications were: underweight (<18.5 kg/m^2); normal weight (18.5-24.9 kg/m^2); overweight (25.0-29.9 kg/m^2); or obese (30+ kg/m^2).

Data Analyses

Data analyses occurred in a three-step process. First, descriptive statistics were used to describe each measure. All variables included in this study were categorical so each was described in terms of sample sizes and valid percentages. Second, bivariate logistic regression was used to estimate the unadjusted associations between chronic disease and physical activity, as well as pain-related functional impairment and physical activity. This analytical approach was appropriate as the physical activity outcome variable was dichotomous (i.e., active vs. inactive). Third, multivariate logistic regression was used to re-estimate the two aforementioned bivariate associations; however, these results were adjusted through the inclusion of all covariates in the full model. Given that the research objective was to examine these associations within middle- and older-age groups, all analyses were performed first on the overall sample (40+ years) and then were performed stratified by age group classification (mid life: 40-59 years, later life: 60+ years). All analyses were completed using IBM SPSS 22.[34]

Results

Descriptive Statistics

Overall and age group-specific descriptive statistics are found in Table 1. There are a number of commonalities and important differences observed when describing the mode results among these samples. For the most part, the overall sample as well as the middle-aged and older adult samples reported having a chronic condition (Overall Sample (OS) = 73%, Middle-Aged Adults (MA) = 62%, Older Adults (OA) = 82%). Most participants within the samples reported not experiencing pain-related functional impairment (OS = 71%, MA = 73%, OA = 69%). Regarding physical activity, the mode of the overall sample was classified as inactive (51%); however, with further inspection of the age groups, the mode for middle-aged adult group was active (52%), but for the older adult group it was inactive (54%).

[Table 1]

Pertaining to the covariates across the samples, the majority of participants were: female (OS = 56%, MA = 54%, OA = 58%); White ethnicity (OS = 90%, MA = 87%, OA = 93%); married (OS = 52%, MA = 53%, OA = 52%); and with post-secondary levels of education (OS = 56%, MA = 65%, OA = 49%). Other findings pertaining to the covariates were less consistent. Total household income for the overall sample was bimodal in nature (i.e., 26% = $20,000-$39,999; 27% = $80,000+), which was explained by the mode results of the two age groups (i.e., MA: 41% = $80,000+ and OA: 34% = $20,000-$39,999). Regarding self-perceived health, the majority of all samples rated their health as either good or very good (OS = 66%, MA = 68%, OA = 65%); however, the mode for the overall sample and middle-aged adult group was very good (OS = 35%, MA = 38%), while for older adult group it was good (33%). Lastly, for BMI, the majority of all samples were either healthy weight or overweight (OS = 76%, MA = 74%,

OA = 77%); however, the mode for the overall sample and middle-aged adult group was healthy weight (OS = 38%, MA = 38%), while for older adult group it was overweight (39%).

Bivariate Regression Results

The unadjusted associations between chronic disease and physical activity, as well as pain-related functional impairment and physical activity presented together in Table 2. Regarding chronic disease in the overall sample, those without a diagnosis of chronic disease were 1.6 times more likely to be physically active (95%CI = 1.55-1.66) than those with a chronic disease. However, upon examining the age group-stratified results, the relative odds of being active among those without a chronic disease was lower among middle-aged adults and higher among older age adults. More specifically, middle-aged adults without chronic disease were 1.4 times more likely to be active (95% CI = 1.34-1.46), while older adults without chronic disease were 1.8 times more likely to be physically active (95%CI = 1.68-1.85), both compared to their age group-matched peers with a chronic disease.

[Table 2]

Regarding pain-related functional impairment, there was a clear and consistent unadjusted association between the presence of, and extent to which, pain was associated with the restriction of activities and the likelihood of physical activity. Generally, as pain and the restriction of activities increased, the odds of being physically active decreased. Although the reliability and strength of this negative association may not be surprising, there are nonetheless interesting findings observed between the middle-aged and older adult groups. To illustrate, in the overall sample, those reporting no pain were 3.0 times more likely to be physically active compared to those with pain that prevented most activities (95%CI = 2.84-3.23). However, middle-aged adults with no pain were 2.5 times more likely to engage in physical activity

compared to those with pain that prevented most activities (95%CI = 2.31-2.78), while older adults reporting these same characteristics were 3.5 times more likely to engage in physical activity (95%CI = 3.22-3.87).

Multivariate Regression Results

The adjusted associations for all measures included in the full multivariate model are presented in Table 3. After adjusting for sex, ethnicity, relationship status, total household income, highest level of education, self-perceived health, and BMI, the association between chronic disease and physical activity was no longer statistically significant for either the overall sample or the middle-aged adult group (both $p > .05$). Therefore, the odds of being physically active for those without a chronic condition did not significantly differ from those with a chronic condition. However, the significance of this association was found for the older adult group. Older adults without diagnosis of a chronic disease were 1.1 times more likely to be physically active than those with a chronic disease (95%CI = 1.06-1.19).

[Table 3]

All of the associations between pain-related functional impairment and physical activity remained statistically significant after adjusting for the covariates for the overall, middle-aged, and older adult samples. Compared to those who reported having pain that prevents most activities, participants with no pain in the overall sample were 1.5 times more likely to engage in physical activity (95%CI = 1.43-1.67), while those in the middle-aged and older adult groups were 1.3 and 1.8 times more likely to engage in physical activity, respectively (MA: 95%CI = 1.17-1.47; OA: 95%CI = 1.64-2.02). However, the general unadjusted trends observed between the presence of, and extent to which, pain was associated with the restriction of activities and the likelihood of physical activity was less clear after adjustment. For instance, groups reporting *no*

pain were no longer the most likely sub-group to be physically active. Rather, participants experiencing *some* pain but not to the extent that it restricts activities now demonstrated the highest odds of being engaged in physical activity among those in the overall sample, the middle-aged group, and the older group alike (OS: OR= 1.68, 95%CI = 1.53-1.84; MA: OR = 1.37, 95%CI = 1.20-1.57; OA: OR = 2.05, 95%CI = 1.81-2.32).

Also found in Table 3 are the associations between each covariate included in the full multivariate model and physical activity. Associations between education, self-perceived health, and BMI demonstrated similar trends within the three samples, but some had pronounced age cohort-specific results. Generally, higher levels of education were associated with greater odds of being physically active, but this association was more pronounced in the middle-aged group than the older group; higher levels of self-perceived health were associated with much greater odds of being physically active, but this association was more pronounced in the older group than the middle-aged group; and participants with healthier weights had the greatest odds of being physically active. Regarding total household income, the overall sample and older group demonstrated positive associations such that as income level increased the odds of being physically active also increased. However, this trend was not found within the middle-aged group. Similarly, significant associations were found for sex within the overall sample and older group, which demonstrated that males had an increased likelihood of being physically active than females, but this association was not significant for the middle-aged group. Conversely, White participants in the overall sample and middle-aged group were more likely to be physically active than participants belonging to visible minority groups, but this association was not found for the older group. Regarding martial status, findings varied according to sample and age group. Widows/widowers were the least likely to be physically active in the overall sample, while those

in common law relationships were the least likely to be physically active in mid-life. However, those in common law relationships were the most likely to be physically active in later life.

Discussion

This study expanded existing knowledge on the factors that can be used to understand and support physical activity in an aging population. Analyses examined conditions of chronic disease and pain-related functional impairment, both common states of physical health with aging, as associates of physical activity engagement among middle-aged and older adults in Canada. It was found that older adults with no chronic disease were more likely to engage in physical activity, while both middle-aged and older aged adults who reported having no pain or some pain without restriction of activities were also more likely to engage in physical activity. In addition, although a number of associations and trends were found within and across the age group samples, there were several notable differences as well. These age cohort-specific findings in particular provide further evidence for demographically-targeted physical activity promotion strategies and interventions that are discussed below.

Chronic Disease and Physical Activity

Given the prevalence of chronic disease in an aging population, this condition is an important population characteristic to understand and target for physical activity promotion. In this study, 82% of older participants were diagnosed with a chronic disease, compared to 62% of middle-aged participants. Research supports this finding as that older adult groups tend to have a higher prevalence of numerous chronic diseases compared to relatively younger groups.[7-8] Regarding the association between chronic disease and physical activity, it was found that older adults, but not middle-aged adults, without diagnosis of a chronic disease were more likely to be physically active compared to those with a chronic disease. This finding is well documented in

the extant research. For instance, it is shown that older adults with chronic conditions tend not to meet physical activity requirements more often than those without chronic conditions.[19,24] Van den Berg-Emons, Bussmann, and Stam found that people with chronic conditions had about a 40% lower rate of physical activity than those without.[35]

A possible explanation for this older age group specific finding is that older adults who are diagnosed with a chronic disease earlier in life may accumulate chronic disease-related deficits over time, including decreased physical activity levels, that may result in a more severe or negatively impactful condition. Conversely, middle-aged adults may experience a new (or fewer) chronic disease(s) and not yet have had the time to experience as much (or as many) of these deficits. Therefore, chronic disease prevention-focused efforts should target middle-aged (and younger) adults, while efforts tailored to older adults should provide a combination of chronic disease prevention, management, and harm reduction approaches. By employing these targeted and tailored strategies, future new chronic disease diagnoses can be prevented, already diagnosed conditions and associated symptomology can be appropriately managed, as well as symptom worsening and chronic disease progression can be mitigated.

Pain-Related Functional Impairment and Physical Activity

In the current study, the likelihood of being physically active was higher among those with no or low levels of pain and functional impairment, and as pain-related impairment increased the odds of being physically active decreased. This finding was significant and consistent among the overall sample as well as the middle-aged and older adult groups. In the extant literature, the presence of pain is shown to significantly reduce physical activity levels.[24] When individuals experience pain, either before or during physical activity, it is likely to result in the avoidance or cessation of activity due to actual discomfort or the apprehension of causing

more pain from being physically active.[36,37] Contrary to the popular belief that physical activity will cause pain among middle-aged and older adults, physical activity is shown to provide current pain relief, and prevent future pain as well.[38]

Importantly, the association between pain-related functional impairment and physical activity was most prominent among older adults than middle-aged adults. A possible explanation for this trend is that older adults tend to experience more pain that is characterized as persisting (i.e., chronic pain for more than three months), while experiences of pain among relatively younger groups is often more acute and sporadic.[14] For older adults who experience pain that persists for several months or years, their physical activity levels would be more heavily impacted, for longer periods of time, compared to other age groups who experience pain for more transient periods of time.

Another interesting finding regarding pain-related functional impairment was that those reporting no pain did not demonstrate the greatest odds of being physically active, while those experiencing *some* pain but with no restriction of activities did. This result highlights that it is not merely absence or presence of pain that affects physical activity participation. Rather, it is the extent to which pain limits a persons' ability to be physically active. The implication of this finding is important. It demonstrates the value of pain control and management as a means to support physical activity engagement among middle-aged and older adults, more so than complete pain relief. Patterns of chronic pain vary throughout the course of even a day.[39] Thus, the experience of chronic pain itself does not necessitate a prolonged decreased physical activity. In fact, it could be possible that experiencing some pain may act as a 'wake-up call' or motivating trigger among those who are inactive to start engaging in physical activity. Understanding individual pain fluctuations, cycles and experiences, as well as appropriately

assessing the extent to which pain influences physical activity engagement and motivation, are important components of future health promotion strategies and intervention plans. Educational programs designed for middle-aged and older adults experiencing low or even moderate levels of pain and restriction of activities could be delivered. This programming could provide these groups with the knowledge and skills necessary to effectively negotiate their experiences and perceptions of pain with their adapted engagement and perceptions of physical activity.

Covariates and Physical Activity

Although not the primary objective of this paper, there were a number of covariates that were also independently associated with being physically active, all of which are supported by previous literature. For example, the importance of higher levels of education,[24,25,40] self-perceived health,[5,41] and income;[24] having a healthy BMI;[42] being male;[24,43-45] being White ethnicity;[46] and having a spouse or partner.[40] In this study, self-perceived health, education, and sex demonstrated the strongest effects on physical activity participation overall.

However, the novel contributions of the current study are found between the age groups because some covariates demonstrated cohort specific and/or pronounced associations. For example, the associations between education and physical activity as well as White ethnicity and physical activity were stronger among middle-aged adults than older adults. On the other hand, associations between self-perceived health, total household income, and sex with physical activity were either stronger or only statistically significant among older adults. The age-specific associations for relationship status were less obvious as middle-aged adults in common law relationships were less likely to be physically active, while common law older adults were more likely to be physically active. The presence and proposed directionality of these age group

specific associations and characteristics are useful to consider in the design and delivery of future physical activity interventions tailored for middle-aged and/or older adults.

It is also important to note that some of these covariate factors are modifiable, such as self-perceptions of health and BMI. These factors provide potential avenues for focused efforts to improve physical activity levels with effects observable in the short term. To illustrate, concentrating on strategies that improve self-perceptions of health and/or allow individuals to achieve and maintain a healthy BMI may be particularly beneficial as both are linked to increased likelihood of engaging in physical activity and both self-perceptions of health and BMI are reciprocally improved through physical activity participation—thereby creating a feedback loop.[5,41]

Although education and income levels are less intra-individually modifiable than self-perceptions of health and BMI, these factors do nonetheless change over the life course of an individual and over time within a population. Focusing on increasing educational and economic attainment among members of the population overall, and especially among socio-politically disadvantaged groups, is a valuable ongoing population health promotion strategy that warrants further multi-sectoral support.[47] These efforts are shown to not only benefit health outcomes, but also physical activity engagement as those with higher educational attainment and income levels are more likely to have, and maintain over time, physically active lifestyles compared to those with lower levels, respectively.[24,25,40] Therefore, future research, programs, and policies should promote these social determinants of health to promote physical activity and/or prevent physical activity disengagement as a way to generate healthy aging outcomes in future generations.[48]

Other factors included in this study that are not easily modifiable from an intervention standpoint in either current or future populations include relationship status, sex, and ethnicity.

Nonetheless, these static characteristics can be used to target those who have lower likelihoods of being physically active specifically within age groups or cohorts. Findings from this study indicate that those who are widows or widowers, separated, or divorced at any age as well as middle-aged adults in common law relationships; older females; and middle-aged adults who belong to visible minority groups may benefit from tailored physical activity programming.

Strengths and Limitations

Secondary data used for this study come from a reliable source and, given the rigorous random recruitment process, the dataset is nationally representative. This research focused on a sub-sample of the overall population, including 81,178 participants. Due to this substantial sample size, findings can be generalized to other middle-aged and older adults in Canada. However, there are a few limitations of this study that warrant consideration related to the use of secondary data. First, the CCHS is cross-sectional, which cannot be used to discern the directionality of the estimated associations. Therefore, it cannot be determined if physical inactivity caused chronic disease and pain-related functional impairment, or vice versa. However, it is important to note that this study did not aim to determine the causal nature of these relationships. Rather, the study objective was to generate a descriptive profile of the odds of being physically active depending on certain factors for purposes of future strategies and interventions to promote physical activity and healthy aging.

Second, given the use of an existing database, there was no control over how measures were assessed, coded, or categorized as CCHS survey was formed prior to this study. For example, the CCHS 'Physical Activity Index' included an assorted and aggregated set of specified physical activities including a range of exercise and leisure activities (e.g., walking for exercise, gardening or yard work, home exercises, jogging or running, etc.). As such, the

individual reported activities may not be equally represented between middle-aged and older adults or across chronic disease or pain-related functional impairment categories. Future researchers who wish to replicate, authenticate, and/or extend these current findings may consider the benefits of using different, more specific measurement tools. Regardless of these potential limitations, the variables used in the present study were directly related to the current research question and were appropriate to use for generating a population-level description of some important factors that influence physical activity in mid- and later-life. Third, data were self-reported that relies on recall. This limitation is particularly important in terms of the physical activity measure. Future research could examine the associations found among middle-aged and older adults in this study using accelerometer data to assess the extent to which results were influenced by self-reporting bias.[49]

It is also important to note that the age cohort differences and trends observed in this study may not be entirely explained by age and/or life stage factors as discussed. It is also likely that the significant differences found reflect, at least partially, cohort-specific characteristics and generational history. To illustrate, unlike current older adults, middle-aged adults grew up in a time when the importance of being physically active and having a healthy lifestyle was a key part of Canadian culture (via educational systems, media, physical activity guidelines, increased accessibility of fitness facilities, increased variety of at-home exercise equipment, etc.).[50,51] Indeed, physical activity levels of Canadian adults have significantly increased in past decades as a result of population-level interventions.[52] Thus, different physical activity patterns between middle-aged and older adults found in this study should be considered in light of this evidence.

Conclusion

Health is still often understood as the absence of disease and disability. However, the definition of health and healthy aging have evolved to encompass components of individual- to population-levels of biological, psychological, and social well-being.[17,48,53] Indeed, it is possible to live healthfully despite acquiring chronic conditions and/or pain and functional impairment during the life course. The current research supports physical activity and healthy aging promotion efforts among those with chronic disease and/or pain-related functional impairment. The current findings contribute further evidence that physical activity, even broadly defined, plays an important role in understanding, promoting, and challenging the concept of 'healthy aging,' especially among those with chronic disease and pain-related functional impairment.

By focusing on current cohorts of older and middle-aged adults (the later group also serving as future older adults), this study provides important information on current physical activity practices and patterns in mid- and later-life in terms of prevalent health-related conditions such as chronic disease and pain-related functional impairment. This study also provides useful information for the development, design, and delivery of tailored physical activity promotion strategies and interventions that target specific age groups and/or age group characteristics of the population with particular physical activity needs. This deeper understanding of age cohort associations is important for multiple and interdisciplinary health practitioners and professionals who engage in evidence-based care or service delivery. As well, institution, community, and government stakeholders who are involved in physical activity and/or healthy aging programs and policies for Canadians in mid- and later-life could also benefit from these findings in their efforts to enhance physical activity and health and/or reduce the risk of chronic disease, pain-related disability, and associated impairments among the fastest growing segments of the population. These initiatives, activities, and collaborations can take a

treatment- and/or prevention-focused approach. Together, they will help address health-related conditions and experiences for the current as well as future cohorts and generations of older adults in Canada. Other countries may too benefit from these findings, depending on how physical activity, chronic disease, and pain-related functional impairment are experienced in their cultures and age cohorts.

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