BRIEF COMMUNICATION / COMMUNICATION BRÈVE

Health care costs of physical inactivity in Canadian adults

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Abstract: The purpose of this study was to provide a contemporary estimate of the health care cost of physical inactivity in Canadian adults. The health care cost was estimated using a prevalence-based approach. The estimated direct, indirect, and total health care costs of physical inactivity in Canada in 2009 were $2.4 billion, $4.3 billion, and $6.8 billion, respectively. These values represented 3.8%, 3.6%, and 3.7% of the overall health care costs.

Key words: physical activity, health care costs, Canada.

Résumé : Cette étude se propose de fournir une estimation contemporaine des coûts des soins de santé engendrés par l'inactivité physique des adultes canadiens. L'estimation des coûts des soins de santé se fait au moyen d'une approche fondée sur la prévalence. Les coûts directs, indirects et totaux de l'inactivité physique au Canada en 2009 sont de 2,4 milliards, 4,3 milliards et 6,8 milliards de dollars, respectivement. Ces valeurs représentent 3,8 %, 3,6 % et 3,7 % des coûts totaux des soins de santé.

Mots-clés : activité physique, coûts des soins de santé, Canada.

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Introduction

Physical inactivity is a recognized public health issue in Canada and globally (Secretariat for the Intersectoral Healthy Living Network 2005; World Health Organization 2010). A common approach for assessing the public health impact of physical inactivity is to measure the prevalence of the population not meeting physical activity guidelines. Recent surveillance data based on objective measures indicate that 85% of Canadian adults do not meet Canada's physical activity guidelines of 150 min/week of moderate-to-vigorous physical activity (Colley et al. 2011). A second approach for assessing the public health impact of physical inactivity is to estimate the proportion of a disease within the population that is directly attributable to physical inactivity. For instance, 19% of the coronary artery disease cases in Canadian men are due to physical inactivity (Katzmarzyk and Janssen 2004). A third approach for assessing the public health impact of physical inactivity is to estimate the financial burden it places on the health care system and economy. The most recent Canadian estimates, based on 2001 data, suggest that the annual economic burden of physical inactivity is $5.3 billion (Katzmarzyk and Janssen 2004). These economic data provide valuable information to researchers, public health practitioners, and policy workers who need to convey in their grants, scientific papers, presentations, reports, etc. the impact of the physical inactivity epidemic. As evidence of this, as of April 2012 the mostly highly referenced paper published by *Applied Physiology, Nutrition, and Metabolism* was the paper that reported on the economic burden of physical inactivity in Canada for 2001 (NRC Research Press 2012).

Although informative, the $5.3 billion cost estimate for 2001 is outdated. Annual health care expenditures have increased considerably within the past decade (Canadian Institutes for Health Information 2008). Furthermore, the 2001 estimates were based in part on a physical inactivity prevalence of 53% as determined from questionnaire measures, which considerably underestimate physical activity levels (Prince et al. 2008). Therefore, the purpose of this brief communication was to provide a contemporary estimate of the health care costs of physical inactivity in Canada.

Methods

Similar to the 2001 estimates (Katzmarzyk and Janssen 2004), the health care cost of physical inactivity in this report was estimated using a prevalence-based approach, which required 3 pieces of information: (1) the risks of chronic conditions in physically inactive individuals, (2) the direct and

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Table 1. Summary relative risk estimates for physical inactivity for the 7 physical inactivity-related chronic diseases.

Chronic disease	Summary relative risk (95% confidence interval)
Coronary artery disease	1.43 (1.37–1.49)
Stroke	1.40 (1.30–1.51)
Hypertension	1.36 (1.28–1.45)
Colon cancer	1.37 (1.29–1.46)
Breast cancer (women only)	1.21 (1.16–1.25)
Type 2 diabetes	1.74 (1.65–1.83)
Osteoporosis	1.57 (1.38–1.77)

indirect costs of these chronic diseases, and (3) the prevalence of physical inactivity in the population. The estimates were completed in the following 3 steps.

Step 1. The first step involved performing a meta-analysis to determine the risks of chronic disease in physically inactive persons relative to physically active persons. The meta-analysis was based upon a comprehensive list of prospective cohort studies, which assessed the relationship between physical inactivity and chronic disease in adults, that was published in 2004 (Katzmarzyk and Janssen 2004) and was updated to include more recent studies that were identified in a systematic review published in 2010 (Warburton et al. 2010). Seven chronic diseases that were consistently shown to be associated with physical inactivity were included in the meta-analysis: coronary artery disease, stroke, hypertension, colon cancer, breast cancer (in women only), type 2 diabetes, and osteoporosis. Summary relative risk (RR) estimates were calculated for each of the 7 chronic diseases using a general variance-based method (Petitti 1994), and therefore represent a weighted average of the RR estimates from the published studies. The RRs that were abstracted from the individual studies included in the meta-analysis were the RRs that had been adjusted for relevant confounders (e.g., age, race, socioeconomic status, etc.).

Step 2. The second step was to determine the proportion of the 7 chronic diseases caused by physical inactivity within the adult population, and involved calculating the population attributable risk (PAR%) for each chronic disease. The PAR% combines the summary RR estimate with the population prevalence (P) of physical inactivity as follows:

$$\text{PAR\%} = [\text{P}(\text{RR} - 1)]/[1 + \text{P}(\text{RR} - 1)]$$

For the PAR% calculations, the prevalence of physical inactivity was based upon the nationally representative 2007–2009 Canadian Health Measures Survey (CHMS) (Colley et al. 2011). As explained elsewhere (Colley et al. 2011), physical activity was measured over 7 consecutive days using Actical accelerometers within the CHMS. The prevalence of physical inactivity within adults (≥20 years) within the 2832 CHMS participants, defined as <150 min/week of moderate-to-vigorous physical activity, was 82.9% (95% confidence interval: 80.2%–89.1%) in men and 86.3% (95% confidence interval: 82.7%–90.0%) in women.

Step 3. The third step involved applying the PAR% for each of the 7 chronic diseases to the overall cost of that chronic disease, in order to determine how much of the overall cost was attributable to physical inactivity. The overall direct and indirect costs of the 7 chronic disease, in Canadian dollars, were based on information on the costs of specific diseases in adults (defined as ≥15 years old) in the Economic Burden of Illness in Canada 2000 (EBIC 2000). Direct costs refer to the value of goods and services for which payment was made and resources used in treatment, care, and rehabilitation related to illness or injury (hospital care expenditures, drug expenditures, physician care expenditures, expenditures for care in other institutions, and additional direct health expenditures). Indirect costs refer to the value of economic output lost because of illness, injury-related work disability, or premature death. The EBIC 2000 report has not been released to the public and the specific costs of each of the 7 chronic diseases were made available to the author from the Population Health Economics Section of the Public Health Agency of Canada. EBIC 2000 employed identical methodology to EBIC 1998 (Health Canada 2002). Briefly, with the exception of mortality costs, a prevalence-based approach was used to estimate all direct and indirect costs that accrued to existing (or prevalent) cases of illness, injury, or disability. This approach made the best use of the survey and administrative data that were available for calculating core direct and indirect costs and, in turn, for distributing these costs across primary diagnostic categories. For mortality costs, an incidence-based human capital approach was used. Mortality cost estimates are therefore based on the discounted value of current and future costs of premature deaths.

The PAR% values calculated in step 2 were multiplied by the overall cost of each of the 7 chronic diseases in adult men and women derived from the EBIC 2000. In this way, the health care costs directly attributable to physical inactivity within men and women were estimated. The costs for the year 2000 were then adjusted for inflation and population growth to reflect 2009 values using the following strategies. For direct costs, the 2000 costs were multiplied by the 21.1% increase in health care costs in the Consumer Price Index from 2000 to 2009 (Statistics Canada 2009*b*) and by the 13.8% increase in the adult population from 2000 to 2009 (Statistics Canada 2012). For indirect costs, the 2000 costs were multiplyed by the 4.1% increase in average earnings in Canadian adults (Statistics Canada 2009*a*) from 2000 to 2009 and by the 13.8% increase in the adult population from 2000 to 2009 (Statistics Canada 2012).

To determine the influence of variations in PAR% and health care costs, a 2-way sensitivity analysis was conducted. This sensitivity analysis was performed in a similar manner to that of previous studies on the costs of physical inactivity in Canada (Katzmarzyk et al. 2000; Katzmarzyk and Janssen 2004), wherein each PAR% and chronic disease-specific health care cost was simultaneously varied by ± 20% of the mean estimate.

Results

The summary RR and PAR% values for the 7 chronic diseases are shown in Tables 1 and 2, respectively. The summary RRs indicate that the risk of the 7 chronic diseases was increased by 21% (breast cancer) to 74% (type 2 diabetes) within physically inactive adults by comparison to active adults. The PAR% values indicate that between 23.0% (hypertension) and 38.0% (type 2 diabetes) of the chronic

Table 2. Population attributable risk (PAR%) estimates for physical inactivity-related chronic diseases in Canadian men and women in 2009.

	Coronary artery disease	Stroke	Hypertension	Colon cancer	Breast cancer	Type 2 diabetes	Osteoporosis
Men	26.3	24.9	23.0	23.5	NA	38.0	32.1
Women	27.1	25.7	23.7	24.2	15.3	39.0	33.0

Note: NA, not applicable.

Table 3. Direct, indirect, and total costs of physical inactivity in Canadian adults in 2009.

	Cost attributable to physical inactivity*			% of overall cost attributable to physical inactivity†		
Sex	Direct	Indirect	Total	Direct	Indirect	Total
Men	1203	2595	3798	3.8	4.3	4.1
Women	1238	1721	2959	3.9	2.9	3.2
Both sexes	2441	4316	6757	3.8	3.6	3.7

*Costs are in millions of Canadian dollars.

†Calculated as cost attributable to physical inactivity in adults / overall cost in population × 100.

Table 4. Direct, indirect, and total costs of physical inactivity for specific chronic diseases in Canadian adults in 2009.

	Cost attributable to physical inactivity*		
Chronic disease	Direct	Indirect	Total
Coronary artery disease	767	1950	2712
Stroke	386	751	1137
Hypertension	588	160	748
Colon cancer	61	283	344
Breast cancer	24	196	220
Type 2 diabetes	470	880	1350
Osteoporosis	146	95	241

*Costs are in millions of Canadian dollars.

diseases were attributable to physical inactivity within Canadian men, and that between 15.3% (breast cancer) and 39.0% (type 2 diabetes) of the chronic diseases were attributable to physical inactivity within Canadian women.

The estimated direct, indirect, and total costs of physical inactivity in Canadian dollars are reported in Table 3. The estimates suggest that the direct, indirect, and total costs of physical inactivity in Canada in 2009 were $2.4 billion, $4.3 billion, and $6.8 billion, respectively. These values represented 3.8%, 3.6%, and 3.7% of the overall health care costs for 2009. The sensitivity analysis indicated that the health care costs for physical inactivity may have been as low as $4.3 billion ($1.6 billion in direct costs and $2.8 billion in indirect costs) and as high as $9.3 billion ($3.1 billion in direct costs and $6.1 billion in indirect costs). The 3 most expensive chronic diseases attributable to physical inactivity were coronary artery disease ($2.7 billion), type 2 diabetes ($1.4 billion), and stroke ($1.1 billion) (Table 4).

Discussion

These results confirm that physical inactivity is a major contributor to chronic disease and health care spending in Canada. Specifically, 15% to 39% of the 7 chronic diseases examined were attributable to physical inactivity. The 2009 estimates indicate that the total annual economic burden of physical inactivity in Canadian adults was $6.8 billion, which represented 3.8% of the overall health care costs.

Two previous studies have provided national estimates of the economic impact of physical inactivity in Canada (Katzmarzyk et al. 2000; Katzmarzyk and Janssen 2004). Although there were some differences, the 2 previous studies used similar methodology to that used here. However, unlike the present study, both relied on self-reported measures of physical inactivity to generate the prevalences that were used for the PAR% estimates. The first of these studies only estimated the direct health care costs (Katzmarzyk et al. 2000). That study suggested that physical inactivity accounted for $2.1 billion in direct health care costs in 1999, which represented 2.5% of the overall direct costs for that year. The second study suggested that physical inactivity accounted for $5.3 billion in direct and indirect costs in 2001, which represented 2.6% of the overall costs for that year. Inflation, population growth, and reliance upon directly measured physical activity data for the physical inactivity prevalences are key factors that contributed to the higher cost estimates for the year 2009 that are presented in this article.

In addition to Canada, population-level data on the economic burden of physical inactivity have been presented for Australia (7% of total health burden) (Begg et al. 2007), Switzerland (1.8% of total direct costs) (Martina et al. 2001), the United Kingdom (1.5% of total direct costs) (Allender et al. 2007), and the United States (2.4% of total direct costs) (Colditz 1999). The proportional physical inactivity costs estimates for Canada presented in this paper (~3.7% of overall and direct costs) fall within the range of values found in these countries. The discrepancies across countries can be explained by several factors, such as differences in the prevalence of physical inactivity, differences in the health care systems (e.g., public vs. private health care), and different methodological approaches for estimating economic costs.

This study used a prevalence-based cost-of-illness methodology. The use of a meta-analytical approach to summarize

the available studies rather than relying on RRs from a single study is a strength of the analysis. However, using the prevalence-based approach produces cost estimates that are more theoretical (e.g., rely on several assumptions) than concrete. Another limitation is the fact that the cost estimates were based on 7 chronic diseases even though physical inactivity may be a risk factor for other illnesses and diseases (e.g., peripheral artery disease, depression, dementia, prostate cancer, lung cancer) (Physical Activity Guidelines Advisory Committee 2008; Warburton et al. 2006). A lack of consistent prospective findings linking physical inactivity and other diseases led to a more conservative approach for the current analysis. By only including 7 of the physical inactivity-related diseases, this report likely underestimates the full economic impact of physical inactivity. In addition, the indirect costs were a function of workforce production and did not consider household production, which previous studies have suggested is quite meaningful (Cadilhac et al. 2011). Finally, the EBIC 2000 data had to be adjusted for population growth and inflation to reflect more current values. By doing so, it was assumed that the relative contribution of the costs of the 7 chronic diseases to overall health care expenditures remained constant over time.

In summary, physical inactivity has surpassed epidemic proportions in Canada and accounts for a significant portion of health care spending. Future studies should use cost-effectiveness methodologies to better inform public health policy. Such studies could address whether reducing physical inactivity levels in the population, by investing in health promotion, substantially reduces health care spending over the long-term.

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