Health & Fitness Journal of Canada

Volume 4 **December 30, 2011** **Number 4**

ORIGINAL ARTICLE

The Economic Costs Associated with Physical Inactivity and Obesity in Ontario

Peter T. Katzmarzyk[1]

Abstract

Background: Physical inactivity and obesity are highly prevalent in every Canadian province and territory. *Purpose:* To estimate the economic costs of physical inactivity and obesity for the province of Ontario in 2009. *Methods:* A prevalence-based economic burden analysis was undertaken. The relative risks of diseases associated with physical inactivity and obesity were determined from a meta-analysis of existing prospective studies and applied to the health care costs of these diseases in Ontario. The prevalences of physical inactivity and obesity were obtained from the 2009 Canadian Community Health Survey (CCHS) for the province of Ontario. Estimates of the economic burden were derived from both direct and indirect expenditure categories. Direct medical costs included hospital care expenditures, drug expenditures, physician care expenditures, expenditures for care in other institutions, and additional direct health expenditures; whereas indirect costs included the value of years of life lost due to premature death and the value of days lost due to short-term and long-term disability. *Results:* The prevalences of physical inactivity (<1.5 kcal·kg^{-1}·day^{-1} of leisure time energy expenditure) and obesity (body mass index ≥30 kg/m^2) among Ontario adults for 2009 were 49.3% and 25.4%, respectively. The economic burden of physical inactivity was $3.4 billion ($1.02 billion in direct costs and $2.34 billion in indirect costs) while the burden associated with obesity was $4.5 billion ($1.60 billion in direct costs and $2.87 billion in indirect costs). *Conclusions:* These estimates reinforce the public health importance of curbing the current epidemics of physical inactivity and obesity in Ontario. **Health & Fitness Journal of Canada 2011;4(4):31-40.**

Keywords: overweight; exercise; economic burden; cost-of-illness; population attributable risk; lifestyle

From the [1]Pennington Biomedical Research Center, 6400 Perkins Road, Baton Rouge, LA 70808-4124. Email: Peter.Katzmarzyk@pbrc.edu

Introduction

National estimates of the economic burden attributed to obesity and physical inactivity have been reported for Canada (Anis et al., 2010; Birmingham et al., 1999; Katzmarzyk et al., 2000; Katzmarzyk and Janssen, 2004). However, these estimates will vary from province to province due to regional differences in the prevalences of physical inactivity and obesity and total provincial health care expenditures. The economic costs of physical inactivity and obesity have been previously reported for Ontario for 2001 (Katzmarzyk and Janssen, 2003). At that time the cost associated with physical inactivity was estimated at $1.8 billion ($634 million direct, $1.2 billion indirect) and the cost associated with obesity was estimated at $1.6 billion ($647 million direct, $905 million indirect). These estimates are now 10 years old, and given that there have been increases in total medical expenditures in Ontario as well as changes in the prevalences of physical inactivity and obesity, these estimates may no longer provide an accurate assessment of the current situation.

The purpose of this study is to update the economic cost estimates for physical inactivity and obesity for Ontario in 2009, and to estimate trends in costs over time. Potential temporal changes in the cost estimates may be due to changes in the prevalence of physical inactivity and obesity, as well as increases in medical expenditures within the province of Ontario between 2001 and 2009.

Methods

The economic costs of physical inactivity and obesity in Ontario were estimated using a prevalence-based approach. In order to ensure comparability to an earlier report on the economic costs of physical inactivity and obesity in Canada (Katzmarzyk and Janssen, 2004), the same analytical strategy was employed in the current report. First, the relationships between physical inactivity, obesity and associated chronic diseases were obtained from a published meta-analysis of prospective longitudinal studies (Katzmarzyk and Janssen, 2004). Summary relative risk (RR) estimates were calculated using a general variance-based method of meta-analysis. Seven chronic diseases have been consistently shown to be associated with physical inactivity, including coronary artery disease, stroke, hypertension, colon cancer, breast cancer, type 2 diabetes, and osteoporosis. There are sufficient long term prospective studies to identify eight diseases associated with obesity, which include coronary artery disease, stroke, hypertension, colon cancer, post-menopausal breast cancer, type 2 diabetes, gall bladder disease and osteoarthritis.

The impacts of physical inactivity and obesity on society were then estimated by calculating the population attributable risks (PAR%) for each disease, which combines the summary RR estimate with the population prevalence (P) of physical inactivity or obesity as follows: PAR% = [P(RR-1)]/[1+(RR-1)].

For the purpose of calculating the PAR%, the prevalences of physical inactivity and obesity in Ontario were obtained from the 2009 Canadian Community Health Survey (CCHS). The prevalence of physical inactivity [expending < 6.3 $kJ \cdot kg^{-1} \cdot day^{-1}$(<1.5 $kcal \cdot kg^{-1} \cdot day^{-1}$)] in leisure-time among Ontarians 12 years and older was 49.3% in the 2009 CCHS (Statistics Canada, 2011), so this value was used to model the economic costs of physical inactivity in this report.

The true prevalence of obesity (body mass index [BMI] ≥ 30 kg/m^2)(Health Canada, 2003) among Ontario adults was estimated from self-reported height and weight data from the 2009 CCHS among adults 18 years of age and older. The self-reported prevalence of obesity in Ontario in 2009 was 17.4% (Statistics Canada, 2011). However, given the known bias in using self-reported data (people tend to under-report their weight and over-report their height) (Connor Gorber et al., 2007), this estimate was adjusted upwards to better reflect the true prevalence by applying a factor derived from data from the 2008 CCHS in which both self-reported and measured BMI data were collected. In that survey, the self-reported prevalence was 17.2%, and the measured prevalence was 25.1%. Thus, a correction factor of 1.4593 (25.1/17.2) was applied to the 17.4% prevalence of self-reported obesity for Ontario in 2009, resulting in an estimated prevalence of 25.4%, which was used to estimate the economic costs of obesity in this report.

The direct and indirect costs of the diseases related to (not attributed to)

physical inactivity and obesity were primarily estimated from information on the costs of specific diseases in the *Economic Burden of Illness in Canada, 1998* (*EBIC 1998; Health Canada, 2002)* and in the *Economic Burden of Illness in Canada, 1993* (*EBIC 1993; Moore et al., 1997)*. Direct costs are defined as the values of goods and services for which payment was made and resources used in treatment, care, and rehabilitation related to illness or injury. The five direct cost components of the *EBIC 1998* include hospital care expenditures, drug expenditures, physician care expenditures, expenditures for care in other institutions, and additional direct health expenditures (including other professionals, public health, health research, prepayment administration, etc.).

Indirect costs are defined as the value of economic output lost because of illness, injury-related work disability, or premature death. The indirect cost components in the *EBIC 1998* were measured in terms of the value of years of life lost due to premature death and the value of activity days lost due to short-term and long-term disability.

The specific costs associated with some diseases were not directly reported in the *EBIC 1998* and were therefore estimated using the following approaches. The *EBIC 1998* reported the total direct and indirect costs of treating cardiovascular disease, but did not have specific costs for coronary artery disease, stroke, and hypertension. The costs of coronary artery disease and stroke for 1998 were estimated by multiplying the proportional costs associated with treating coronary artery disease (28.2% direct, 42.8% indirect) and stroke (19.6% direct, 9.9% indirect) relative to total cardiovascular disease costs that were reported in the *EBIC 1993*. The cost of treating hypertension in 1998 was estimated by multiplying the proportion of direct (17.8%) and indirect (9.2%) cardiovascular disease costs attributable to hypertension in the United States (American Heart Association, 2002).

The *EBIC 1998* provided direct and indirect costs for all cancers combined, and we estimated the costs of treating colon and breast cancers using the actual incidence of colon (9.0%) and breast (14.4%) cancers relative to all newly diagnosed cancers in Canada in 1998 (National Cancer Institute of Canada, 2002). The costs of treating post-menopausal breast cancer was calculated using the estimated incidence of breast cancer in 50+ year old women relative to all Canadian women in 2002 (78%) (National Cancer Institute of Canada, 2002).

The *EBIC 1998* reported the direct and indirect costs of treating endocrine and related diseases, but did not have a specific cost for diabetes. The cost of type 2 diabetes in 1998 was estimated by multiplying the proportion of the direct (43.3%) and indirect (26.8%) endocrine diseases costs that were attributable to diabetes in the *EBIC 1993* and by the proportion of diabetes cases that are type 2 diabetes (92.5%) (U.S. Centers for Disease Control and Prevention, 1997).

The *EBIC 1998* reported the direct and indirect costs of treating digestive diseases, but did not have a specific cost for gall bladder disease. The proportion of digestive diseases cost that was attributable to gall bladder disease in 1998 (15.5%) was calculated by multiplying the cost associated with gall bladder disease in the United States in 1986 (Colditz, 1992) relative to the cost of treating all digestive diseases in the United States in 1980 (Hodgson and

Kopstein, 1984), after the 1980 value was converted to a 1986 value using the medical component of the U.S. Consumer Price Index (U.S. Department of Labor and Bureau of Labor Statistics, 2003).

The *EBIC 1998* reported the direct and indirect costs of treating musculoskeletal diseases, but did not have a cost specifically for osteoarthritis or osteoporosis. The cost of osteoarthritis in 1998 was estimated by multiplying the cost for all musculoskeletal diseases relative to the proportion of musculoskeletal diseases in Ontario that are arthritis (68.2%) (Badley et al., 1994) and the proportion of arthritis cases that are osteoarthritis (49.2%) (Lawrence et al., 1998). The proportion of the direct and indirect costs of treating musculoskeletal diseases in the *EBIC 1998* that were attributable to osteoporosis were determined by dividing the previously calculated direct cost for osteoporosis in Canada in 1993 ($744.4 million) (Goeree et al., 1996), by the total direct cost of musculoskeletal diseases in the *EBIC 1993* (30.3%).

The final step in estimating the health care costs of physical inactivity and obesity was to apply the PAR% values calculated from the RR of disease and population prevalences of physical inactivity and obesity to the health costs derived from the *EBIC 1998* as described above. In this way, the health-care costs directly attributable to physical inactivity and obesity were determined. The health care costs calculated for the diseases of interest in the *EBIC 1998* were inflated to 2009 dollars by using the percentage increase in total health care costs between 1998 ($33,083.7 million) and 2009 ($71,581.6 million) in Ontario (116.4% increase) reported in the National Health Expenditures Database (Canadian Institute for Health Information, 2010) and by assuming that each disease made up a similar percentage of total health care expenditures in 1998 and 2001.

The health care costs for each disease specific for Ontario were determined by multiplying the Canadian values by the proportion of the Canadian costs incurred in Ontario in 2009 (39.3%) (Canadian Institute for Health Information, 2010). These estimates were reported by CIHI, and included public and private health care expenditures (Canadian Institute for Health Information, 2010). The same proportion (39.3%) was applied for direct and indirect costs.

Results

The summary RR estimates for each of the diseases associated with physical inactivity and obesity are presented in Table 1. The higher risk of disease due to physical inactivity ranges from 30% for hypertension to 60% for stroke, while the increased risks of disease associated with obesity ranges from 45% for colon cancer to 350% for hypertension (Katzmarzyk and Janssen, 2004).

The PAR% is a statistic that couples the RR of a disease due to a given risk factor with the prevalence of the risk factor in the population, and reflects the burden of that disease in society that is directly attributable to that risk factor. The PAR% attributable to physical inactivity and obesity for each of the diseases are shown in Table 1. The PAR% values indicate that between 12.9% (hypertension) and 22.8% (stroke) of the chronic diseases that are associated with physical inactivity in Ontario are directly attributable to physical inactivity. Likewise, between 10.3% (colon cancer) and 47.1% (hypertension) of the chronic diseases associated with obesity in Ontario are attributable to obesity.

The total economic burden of physical inactivity (Table 2) was $3.4 billion ($1.02 billion in direct costs and $2.34 billion in indirect costs) while the cost associated with obesity (Table 3) was $4.5 billion ($1.60 billion in direct costs and $2.87 billion in indirect costs) in Ontario for the year 2009. The three most expensive diseases associated with physical inactivity were coronary artery disease ($1.1 billion), osteoporosis ($951 million), and stroke ($483 million); these three diseases accounted for 74% of the total economic costs of physical inactivity. The three most expensive diseases associated with obesity were coronary artery disease ($1.4 billion), hypertension ($954 million), and osteoarthritis ($939 million); these three diseases accounted for 74% of the total economic costs of obesity.

Figure 1 presents the percentage of the economic costs attributable to physical inactivity and obesity in Ontario in 2009 that are from specific diseases. Coronary artery disease accounts for 32% of the inactivity costs, followed by osteoporosis (28%) and stroke (14%). Coronary artery disease also accounts for 32% of the obesity costs, followed by osteoporosis (21%) and hypertension (21%).

Table 1: Summary relative risks (RR) and population attributable risks (PAR%) for physical inactivity and obesity in Ontario, 2009.

Disease	Summary RR*	95% CI	PAR%**
Physical Inactivity			
Coronary Artery Disease	1.45	(1.38-1.54)	18.2
Stroke	1.60	(1.42-1.80)	22.8
Hypertension	1.30	(1.16-1.46)	12.9
Colon Cancer	1.41	(1.31-1.53)	16.8
Breast Cancer	1.31	(1.23-1.38)	13.3
Type 2 Diabetes	1.50	(1.37-1.63)	19.8
Osteoporosis	1.59	(1.40-1.80)	22.5
Obesity			
Coronary Artery Disease	2.24	(2.04-2.45)	24.0
Stroke	1.50	(1.28-1.77)	11.3
Hypertension	4.50	(4.15-4.84)	47.1
Colon Cancer	1.45	(1.23-1.71)	10.3
Post-menopausal Breast Cancer	1.47	(1.40-1.54)	10.7
Type 2 Diabetes	3.73	(3.45-4.06)	40.9
Gall Bladder Disease	3.33	(2.86-3.85)	37.2
Osteoarthritis	1.99	(1.76-2.24)	20.1

*RR estimates are from the meta-analysis of Katzmarzyk and Janssen (2004).
**the PAR% was computed using prevalences of physical inactivity and obesity from the 2009 Canadian Community Health Survey, as described in the methods.

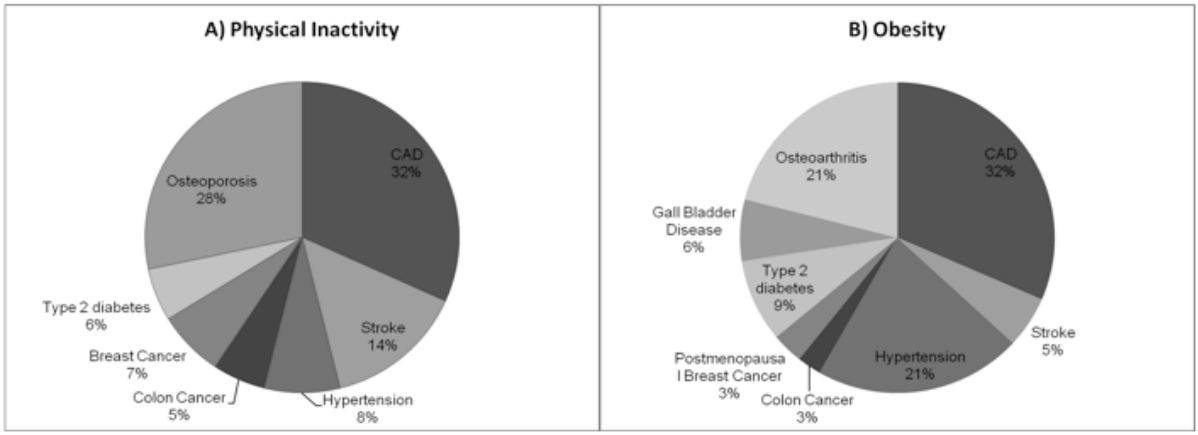
Table 2: Direct and indirect costs ($ millions) of major chronic diseases associated with physical inactivity in Ontario in 2009 and estimated costs attributable to physical inactivity.

Disease	Direct Costs	Indirect Costs	Direct Cost Attributable to Inactivity	Indirect Cost Attributable to Inactivity	Total Cost Attributable to Inactivity
Coronary Artery Disease	1634.9	4241.7	296.9	770.2	1067.0
Stroke	1136.3	981.1	259.4	224.0	483.4
Hypertension	1032.0	995.9	133.0	128.1	261.3
Colon Cancer	188.4	899.8	31.7	151.3	183.0
Breast Cancer	301.5	1439.8	40.0	190.9	230.8
Type 2 Diabetes	539.6	396.3	106.7	78.4	185.1
Osteoporosis	682.4	3538.2	153.8	797.3	951.0
Total			**1021.3**	**2340.2**	**3361.6**

Table 3: Direct and indirect costs ($ millions) of major chronic diseases associated with obesity in Ontario in 2009 and estimated costs attributable to obesity.

Disease	Direct Costs	Indirect Costs	Direct Cost Attributable to Obesity	Indirect Cost Attributable to Obesity	Total Cost Attributable to Obesity
Coronary Artery Disease	1634.9	4241.7	391.6	1016.0	1407.6
Stroke	1136.3	981.1	128.0	110.6	238.6
Hypertension	1032.0	995.9	485.7	486.7	954.4
Colon Cancer	188.4	899.8	19.3	92.3	111.6
Post-menopausal Breast Cancer	235.2	1123.0	25.1	119.8	144.9
Type 2 Diabetes	539.6	396.3	221.0	162.3	383.2
Gall Bladder Disease	466.6	305.0	173.5	113.4	286.9
Osteoarthritis	755.7	3918.3	151.8	787.3	939.2
Total			**1596.0**	**2870.3**	**4466.3**

Figure 1: Proportions of the costs of A) physical inactivity and B) obesity attributable to specific diseases in Ontario in 2009.



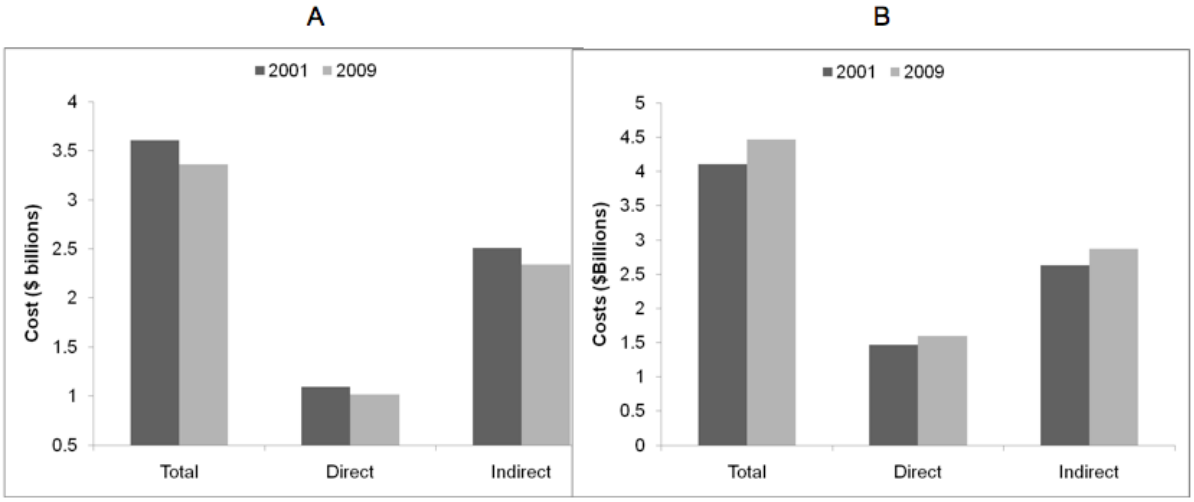
Discussion

The results presented in this study indicate that obesity and physical inactivity continue to be major contributors to the public health burden in Ontario. A previous report that employed the same methodology estimated that in 2001 in Ontario the economic burden of physical inactivity was $1.8 billion and the cost associated with obesity was $1.6 billion (Katzmarzyk and Janssen, 2003). The current estimates for 2009 are substantially higher. There are several reasons for the higher economic estimates attributed to physical inactivity and obesity in 2009 versus 2001 in Ontario. For physical inactivity, the population prevalence has declined slightly (53.9% in 2001 versus 49.3% in 2009); thus the increase in the associated economic costs (from $1.8 billion to $3.4 billion) are largely a function of the overall increases in medical expenditures and associated indirect costs between 2001 and 2009 in Ontario.

The estimate of the economic costs attributable to obesity increased much more than the costs associated with physical inactivity. The increase in the obesity costs are a function of the overall increase in medical costs between 2001 and 2009, and the change in the prevalence of obesity. The estimates for 2001 were based on the self-reported prevalence of obesity available at the time (15.5%)(Katzmarzyk and Janssen, 2003); whereas the 2009 costs are based on a estimate of the true prevalence of obesity (25.4%). The change in the prevalence of obesity resulted in a greater estimate of the PAR, which translates into an increase in the attributable costs.

The medical costs attributable to physical inactivity and obesity will continue to increase in Ontario in proportion to the increase in general medical expenditures unless the prevalences are reduced through prevention and treatment efforts. The impact of the change in physical inactivity prevalence observed between 2001 and 2009 (53.4% to 49.3%) is presented in Figure 2a, controlling for inflation by presenting all results in 2009 dollars. The estimated reduction in economic costs attributed to physical inactivity was

Figure 2: Comparison of the economic costs of A) physical inactivity and B) obesity in Ontario in 2001 and 2009. Values have been standardized to 2009 dollars.



$244.4 million ($74.3 million direct and $170.2 million indirect). Thus, the proportion of the total medical costs associated with physical inactivity have been reduced, but this cost saving has been overwhelmed by the overall increase in medical expenditures between 2001 and 2009.

The impact of the change in obesity prevalence observed between 2001 and 2009 is presented in Figure 2b, controlling for inflation by presenting all results in 2009 dollars. The prevalence of self-reported obesity in 2001 was 15.5%, which was adjusted to an estimate of the true prevalence (22.6%) by applying the same correction factor as to the 2009 data (1.4593). The estimated increase in economic costs attributed to obesity due to the increase in prevalence to 25.4% was $360.6 million ($122.0 million direct and $238.6 million indirect), irrespective of the increase in overall medical expenditures.

The medical costs in Ontario are roughly 39.3% of the national estimates (Canadian Institute for Health Information, 2010). Thus, by extrapolating the Ontario data one could estimate that the national costs attributable to inactivity and obesity in 2009 were roughly $8.6 billion ($2.60 billion direct, $5.95 billion indirect) and $11.4 billion ($4.07 billion direct, $7.30 billion indirect), respectively. A recently published study has also produced national estimates of the costs of obesity for Canada for the year 2006 using a prevalence-based approach (Anis et al., 2010). These authors estimated that the direct medical costs associated with obesity were approximately $3.9 billion, which is similar but slightly lower than the estimate presented here for 2009 ($4.07 billion). These comparisons add to the face validity of the results obtained for Ontario.

Estimates of the economic costs of physical activity have been generated for some other provinces using a similar methodology. For example, it has been estimated that the economic cost of physical inactivity was $354 million annually ($107 million direct and $247 million indirect) for Nova Scotia in 1998 (Colman, 2002), and $573 million annually ($211 million direct and $362 million indirect) in British Columbia in 1998 (Colman and Walker, 2004). The degree to which these costs have changed in the past decade are not known, but based on the results from Ontario, these costs are likely also substantially higher now than in 1998.

This study has several strengths and weaknesses that deserve discussion. The use of summary RR estimates from a meta-analysis rather than the results of single cohort study is a marked strength of this research. Further, the use of robust population-level estimates of the prevalence of physical inactivity and obesity from the Canadian Community Health Survey is also a strength of this study. However, the use of a prevalence-based methodology that relies on PAR% calculations yields theoretical estimates of the effects on economic costs. In order to better establish the true cost-benefit relationships for physical inactivity and obesity intervention strategies, future research studies should employ incidence-based and linkage-based study designs.

Conclusions

The prevalences of physical inactivity (<1.5 $kcal \cdot kg^{-1} \cdot day^{-1}$ of leisure time energy expenditure) and obesity (body mass index ≥30 kg/m^2) among Ontario adults for 2009 are 49.3% and 25.4%,

respectively. The economic burden of physical inactivity was $3.4 billion ($1.02 billion in direct costs and $2.34 billion in indirect costs) while the burden associated with obesity was $4.5 billion ($1.60 billion in direct costs and $2.87 billion in indirect costs). These estimates are a direct reflection of the reported prevalences of physical inactivity and obesity, and the established relationships between physical inactivity, obesity and chronic diseases. Given that there is little evidence for temporal changes in the relationships between physical activity, obesity and chronic diseases, the main strategy for reducing the associated economic burden is to reduce the prevalences. A realization of this strategy will take concerted public health prevention efforts from several jurisdictions.

Acknowledgments

This work was supported by the Ontario Ministry of Health Promotion.

Author Qualifications

The author's qualifications are: Peter T. Katzmarzyk, MSc, PhD, FACSM

References

American Heart Association. (2002). *Heart and Stroke Statistics - 2003 Update*. Dallas, TX: American Heart Association.

Anis, A. H., Zhang, W., Bansback, N., Guh, D. P., Amarsi, Z., and Birmingham, C. L. (2010). Obesity and overweight in Canada: an updated cost-of-illness study. *Obes Rev, 11*(1), 31-40.

Badley, E. M., Rasooly, I., and Webster, G. K. (1994). Relative importance of musculoskeletal disorders as a cause of chronic health problems, disability, and health care utilization: findings from the 1990 Ontario Health Survey. *J Rheumatol, 21*(3), 505-514.

Birmingham, C. L., Muller, J. L., Palepu, A., Spinelli, J. J., and Anis, A. H. (1999). The cost of obesity in Canada. *Can Med Assoc J, 160*, 483-488.

Canadian Institute for Health Information. (2010). Public and Private Sector Health Expenditures by Use of Funds.

Colditz, G. A. (1992). Economic costs of obesity. *Am J Clin Nutr, 55*(2 Suppl), 503S-507S.

Colman, R. (2002). *The Cost of Physical Inactivity in Nova Scotia*: GPI Atlantic for Recreation Nova Scotia and Sport Nova Scotia.

Colman, R., and Walker, S. (2004). *The Cost of Physical Inactivity in British Columbia*: GPI Atlantic for the B.C. Ministry of Health Planning.

Connor Gorber, S., Tremblay, M. S., Moher, D., and Gorber, B. (2007). A comparison of direct vs. self-report measures for assessing height, weight and body mass index: A systematic review. *Obes Rev, 8*, 307-326.

Goeree, R., O'Brien, B., Pettitt, D., Cuddy, L., Ferraz, M., and Adachi, J. (1996). An assessment of the burden of illness due to osteoporosis in Canada. *J Soc Obstet Gynecol Canada*(Supplemental Issue), 15-24.

Health Canada. (2002). *Economic Burden of Illness in Canada, 1998* (Vol. [Cat. N H21-136/1998E]). Ottawa, ON: Minister of Public Works and Government Services Canada.

Health Canada. (2003). *Canadian Guidelines for Body Weight Classification in Adults. Cat. No. H49-179/2003E.* Ottawa, ON: Health Canada.

Hodgson, T. A., and Kopstein, A. N. (1984). Health care expenditures for major diseases in 1980. *Health Care Financ Rev, 5*(4), 1-12.

Katzmarzyk, P. T., Gledhill, N., and Shephard, R. J. (2000). The economic burden of physical inactivity in Canada. *Can Med Assoc J, 163*, 1435-1440.

Katzmarzyk, P. T., and Janssen, I. (2003). *The economic impact of physical inactivity and obesity in Ontario, 2001. Sport & Recreation Branch, Ontario Ministry of Tourism & Recreation.* .

Katzmarzyk, P. T., and Janssen, I. (2004). The economic costs associated with physical inactivity and obesity in Canada: An update. *Can J Appl Physiol, 29*, 90-115.

Lawrence, R. C., Helmick, C. G., Arnett, F. C., Deyo, R. A., Felson, D. T., Giannini, E. H., Heyse, S. P., Hirsch, R., Hochberg, M. C., Hunder, G. G., Liang, M. H., Pillemer, S. R., Steen, V. D., and Wolfe, F. (1998). Estimates of the

prevalence of arthritis and selected musculoskeletal disorders in the United States. *Arthritis Rheum, 41*(5), 778-799.

Moore, R., Mao, Y., Zhang, J., and Clarke, K. (1997). *Economic Burden of Illness in Canada, 1993*. Ottawa, ON: Health Canada.

National Cancer Institute of Canada. (2002). *Canadian Cancer Statistics 2002* (Vol. [ISSN 0835-2976]). Toronto, ON: National Cancer Institute of Canada.

Statistics Canada. (2011). Health indicators, June 21, 2011. *Catalogue # 82-221-XWE*.

U.S. Centers for Disease Control and Prevention. (1997). *National Diabetes Fact Sheet: National Estimates and General Information on Diabetes in the United States*. Atlanta, GA: U.S. Department of Health and Human Services, Center for Disease Control and Prevention.

U.S. Department of Labor, and Bureau of Labor Statistics. (2003). Bureau of Labor Statistics Data. *Accessed www.www.bls.gov/data/ 02/03/03.*