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Genuine Progress Index for Atlantic Canada / Indice de progrès véritable - Atlantique

MEASURING SUSTAINABLE DEVELOPMENT

APPLICATION OF THE GENUINE PROGRESS INDEX TO NOVA SCOTIA

THE COST OF PHYSICAL INACTIVITY IN NOVA SCOTIA

Prepared by:

Ronald Colman, Ph.D, **GPI***Atlantic*

With research assistance from Karen Hayward

For

Recreation Nova Scotia and
Sport Nova Scotia

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Executive Summary

Physical activity provides proven health benefits. It protects against heart disease, stroke, hypertension, type 2 diabetes, colon cancer, breast cancer, osteoporosis, obesity, depression, anxiety, and stress. Epidemiological studies estimate that 36% of heart disease, 27% of osteoporosis, 20% of stroke, hypertension, diabetes 2, and colon cancer, and 11% of breast cancer are attributable to physical inactivity.

Regular physical activity also protects against obesity and assists weight control; fosters development of healthy muscles, bones and joints; increases strength and endurance; improves behavioural development in children and adolescents; and helps maintain function and preserve independence in older adults. Studies show that regular exercisers have much less *overall lifetime morbidity* than those who are sedentary, indicating that avoided medical costs due to physical activity are not simply deferred to older ages.

According to the Canadian Fitness and Lifestyle Research Institute, 62% of Nova Scotians and 61% of Canadians are currently too inactive to reap the health benefits of regular physical activity.

It is estimated that physical inactivity costs the Nova Scotia health care system $66.5 million a year in hospital, physician and drug costs alone, equal to 4% of total government spending on these services. When all direct health care costs are added, including private expenditures, a sedentary lifestyle costs Nova Scotians $107 million a year in direct medical care expenditures.

This spending is currently added to the provincial Gross Domestic Product and economic growth statistics, and is thus mistakenly taken as a sign of prosperity and progress. The Genuine Progress Index counts this spending due to physical inactivity as a cost - not a gain - to the economy.

Physical inactivity costs the Nova Scotia economy an additional $247 million each year in indirect productivity losses due to premature death and disability. Adding direct and indirect costs, the total economic burden of physical inactivity in Nova Scotia is estimated at $354 million annually.

More than 700 Nova Scotians die prematurely each year due to physical inactivity, accounting for 9% of all premature deaths. These premature deaths result in the loss of more than 2,200 potential years of life every year in the province before age 70. In other words, if all Nova Scotians were physically active, the province would gain 2,200 productive years of life each year, with corresponding gains to the economy.

If just 10% fewer Nova Scotians were physically inactive – that is, if the rate of physical inactivity were 56% instead of 62% - the province could save an estimated $4.6 million every year in avoided hospital, drug, and physician costs, and $7.5 million in total health care spending. Added to an estimated $17 million in productivity gains, total economic savings to Nova Scotia from a 10% reduction in physical inactivity amount to $24.7 million.

Given the enormous health care burden of a sedentary lifestyle, health campaigns aimed at promoting regular physical activity, including provision of adequate access to quality sport and recreation programs and facilities for all Nova Scotians, have the potential to reduce the enormous human and economic burden of physical inactivity.

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"If you could bottle everything you get from physical activity and sell it at a pharmacy, it would go for a hefty price."

George Sheehan, M.D.[1]

"Physical activity is the crux of healthy aging. Nowhere is the gap wider between what we know and what we do than in the area of physical activity, and nowhere is the potential pay-off greater."

National Center for Chronic Disease Prevention and Health Promotion, USA[2]

Physical activity has been glowingly referred to as a "magic bullet" because of its proven benefits in preventing disease, improving health, and promoting independence and quality of life in old age.[3] The United Kingdom Minister for Public Health has called physical exercise the best buy in public health.[4] And the most substantial body of evidence for achieving healthy active aging relates to the beneficial effects of regular exercise.[5] Physical activity has been called "the most obvious of variables which might reduce overall lifetime morbidity" and the "cornerstone" of any strategy aimed at prolonging disability-free life expectancy.[6]

In 1992, the American Heart Association officially recognized physical inactivity as one of the four major modifiable risk factors for cardiovascular disease, along with smoking, high blood pressure, and elevated blood cholesterol.[7] However, 24% of Canadians smoke, 11% have high blood pressure, and 18% have high blood cholesterol, while 61% of Canadians are not active enough to reap health benefits.[8] An increase in physical activity, therefore, has the greatest potential to reduce the incidence of heart disease in Canada. In Nova Scotia, the comparable

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[1] Canadian Fitness and Lifestyle Research Institute, *The Research File,* 2000, Reference No. 00-01.

[2] National Center for Chronic Disease Prevention and Health Promotion, "Healthy Aging: Preventing Disease and Improving Quality of Life Among Older Americans," Atlanta, July, 2001, available at http://www.cdc.gov/nccdphp/aag-aging.htm.

[3] Canadian Fitness and Lifestyle Research Institute, *The Research File,* 2000, Reference No. 00-01.

[4] Cooper, Y. Royal College of Physicians, London, June, 2000, cited in Simey, Piers and Dawn Skelton, "Older people need to be encouraged to exercise," *British Medical Journal* 322 (7289), 31 March, 2001, page 796.

[5] Andrews, Gary, "Promoting Health and Function in an Ageing Population," *British Medical Journal* 322 (7288), 24 March, 2001, pages 728-729.

[6] Fries, James, "Physical Activity, the Compression of Morbidity, and the Health of the Elderly," *Journal of the Royal Society of Medicine* 89, 1996, pages 64 and 67.

[7] American Heart Association, "Statement on Exercise: Benefits and recommendations for physical activity programs for all Americans, a statement for health professionals by the Committee on Exercise and Cardiac Rehabilitation of the Council on Clinical Cardiology, American Heart Association, *Circulation* 86, 1992, pages 340-344.

[8] Statistics Canada and Health Canada, *Canadian Tobacco Use Monitoring Survey* 2000; Blood pressure from Statistics Canada, *Health Statistics 1999,* CD-Rom, Table 0060121.IVT; Cholesterol prevalence from Logan, Alexander, *Lowering the Blood Total Cholesterol Level to Prevent Coronary Heart Disease,* Canadian Task Force on Preventive Health Care, June, 1994, available at: http://www.ctfphc.org/Full_Text/Ch54full.htm; Inactivity prevalence from Canadian Fitness and Lifestyle Research Institute, *2000 Physical Activity Monitor,* available at: http://www.cflri.ca/cflri/pa/surveys/2000survey/2000survey.html.

prevalence rates for the major modifiable risk factors are: smoking – 30%; high blood pressure – 17%; high blood cholesterol – 19%; physical inactivity – 62%.[9]

A Harvard Medical School meta-analysis estimated that 22% of coronary heart disease in the U.S. could be attributed to physical inactivity.[10] This means that more than one-fifth of heart disease incidence could be avoided if everyone were physically active. Given that cardiovascular diseases cost the Nova Scotia economy $960 million a year, promotion of physical activity could potentially save substantial sums of money.

A 1999 Statistics Canada analysis of results from the National Population Health Survey, controlling for age, education, income, smoking, blood pressure, weight, and other factors, found that sedentary Canadians have *five times* the risk of developing heart disease as those who exercise moderately in their free time. The same analysis found that those with a low level of regular physical activity had 3.7 times the odds of developing heart disease compared to those who exercised moderately.[11]

The Harvard meta-analysis also found that 22% of colon cancer and osteoporotic fractures, 12% of diabetes and hypertension, and about 5% of breast cancer are attributable to lack of physical activity.[12] Physical inactivity is also linked to obesity, which is itself a risk factor for a wide range of chronic diseases. It is estimated that 19% of premature deaths in Canada are attributable to physical inactivity.[13]

In addition, physical activity provides protection against anxiety and depression. Statistics Canada found that sedentary Canadians are 60% more likely to suffer from depression than those who are active, and concluded that “physical activity has protective effects on heart health and mental health that are independent of many other risk factors.” Regular physical activity has also been shown to foster development of healthy muscles, bones and joints; to improve strength, endurance, and weight control; to improve behavioural development in children and adolescents; and to help maintain function and preserve independence in older adults.[14]

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[9] Statistics Canada, *Canadian Tobacco Use Monitoring Survey* 2000. (Note: Initial data from the first six months of 2001 indicate a potentially significant drop in Nova Scotia smoking rates to 24%, but full year data for 2001, which should be available in July, 2002, are needed to confirm this trend); High blood pressure from Statistics Canada, *Health Statistics 1999,* CD-Rom, Table 0060121.IVT; High blood cholesterol from Heart Health Nova Scotia and Nova Scotia Department of Health, *The Nova Scotia Health Survey, 1995,* Halifax, 1995, page 40; Physical inactivity from Canadian Fitness and Lifestyle Research Institute, *2000 Physical Activity Monitor,* available at: http://www.cflri.ca/cflri/pa/surveys/2000survey/2000survey.html.

[10] Colditz, G.A. (1999), cited in Canadian Fitness and Lifestyle Research Institute (CFLRI), “Physical Activity Pays Big Dividends,” in *The Research File,* reference no. 00-01. A “meta-analysis” examines results from a large number of epidemiological studies. Statistical techniques are then used to estimate relative risks for particular behaviour patterns and the proportion of disease burden attributable to these risk behaviours, taking into account the findings of all studies examined as well as the sample sizes and methodologies of each study.

[11] Chen, Jiajian, and Wayne J. Millar, “Health Effects of Physical Activity,” Statistics Canada, *Health Reports* 11 (1), Summer, 1999, catalogue no. 82-003-XPB, pages 21-30, especially, page 24.

[12] Colditz (1999), in CFLRI, op. cit.

[13] Canadian Fitness and Lifestyle Research Institute, “The Burden of Inactivity,” *The Research File,* reference no. 98-01.

[14] Chen and Millar, op. cit., pages 21-30; U.S. Department of Health and Human Services, *Physical Activity and Health: A Report of the Surgeon-General,* Atlanta, Georgia, 1996, pages 7-8; Prof. Robert Malina (University of Texas), "Physical Activity and Behavioural Development," in Norgan, op. cit., pages 101-120; Prof. Andrew

In sum, a very wide range of chronic diseases could be avoided through increased levels of physical activity in the population. Since the need and demand for medical services and their associated costs are directly linked to the prevalence of illness in society, a reduction in chronic ailments through higher levels of physical activity has the potential to reduce health care costs. Studies have demonstrated that regular exercisers have much less *overall lifetime morbidity* than those who are sedentary, indicating that avoided medical costs due to physical activity can be saved absolutely rather than simply deferred to older ages.[15]

United States health authorities have identified increasing physical activity as a key factor in controlling health care costs in that country, through the prevention of unnecessary illness, disability and premature death, and the maintenance of an improved quality of life into old age.[16] And the U.S. Surgeon-General has issued a "national call to action" to put increased physical activity on the same level as the use of seat belts and the discouragement of tobacco use, because of the strong evidence that it will produce comparable "clear and substantial health gains."[17]

1.1 Biological Pathways

The beneficial effects of physical activity on health have been confirmed by clinical studies identifying the potential biological mechanisms whereby physical activity can influence health. For example, physical activity may help prevent cardiovascular disease by improving the balance between myocardial oxygen supply and demand. It may protect against cancer by increasing the proportion of free radical scavenging enzymes and circulating T and B lymphocytes, thus improving immune function, and by increasing gastrointestinal motility and decreasing the transit time of ingested food.[18]

Physical activity can protect against overweight and diabetes by reducing body fat, increasing the resting metabolic rate and the rate of glucose disposal, and improving cell insulin sensitivity. Regular exercise in childhood can protect against osteoporosis in old age by promoting the development of bone mass, and at older ages it can help maintain bone mineral density. Physical activity can also safeguard mental health through reducing muscle tension (and thereby stress and anxiety) and through biochemical brain alterations and release of endorphins, thereby protecting against depression.[19]

Steptoe (St. George's Hospital Medical Centre, London, "Physical Activity and Psychological Well-being," in Norgan, op. cit., pages 207-229; William P. Morgan (ed.), *Physical Activity and Mental Health,* Taylor and Francis, Washington D.C., 1997.

[15] Fries, James, C. Everett Koop, Jacque Sokolov, Carson Beadle, and Daniel Wright, "Beyond Health Promotion: Reducing the Need and Demand for Medical Care," *Health Affairs* 17 (2), page 71; Fries, James, "Physical Activity, the Compression of Morbidity, and the Health of the Elderly," *Journal of the Royal Society of Medicine,* 89, 1996, page 67.

[16] David Satcher, M.D., Ph.D, Director, U.S. Centers for Disease Control and Prevention, and Philip R. Lee, M.D., Assistant Secretary for Health, in Forward to *Physical Activity and Health: A Report of the U.S. Surgeon-General*, op. cit.

[17] Audrey F. Manley, M.D., Preface to *Physical Activity and Health: A Report of the U.S. Surgeon-General*, op. cit.

[18] This summary is from Slattery, Martha, "How Much Physical Activity Do We Need to Maintain Health and Prevent Disease? Different Diseases – Different Mechanisms," in *Research Quarterly for Exercise and Sport* 67 (2), 1996, page 210.

[19] Idem.

2. Physical Activity Trends in Nova Scotia

2.1 Definitions

There are a number of definitions of physical activity and inactivity that produce varying results when assessing trends in physical activity. Because of the wide range of definitions of physical activity and inactivity, the different types of surveys, the different age groups to which these surveys apply, and the lack of standardization that currently exists, the following analysis provides alternative measures of physical activity.

- Statistics Canada's National Population Health Surveys (NPHS) 1994/95 and 1996/97, and the 2000/01 Canadian Community Health Survey (CCHS) consider Canadians physically inactive or "sedentary" if they report a usual daily leisure-time energy expenditure of less than 1.5 kilocalories per kilogram of body weight per day (kcal/kg/day). Individuals are defined as moderately active if they expend 1.5-2.9 kcal/kg/day, and as "active" if they expend 3.0 or more kcal/kg/day. Calculations are made based on individuals' reporting of the frequency and duration of different types of physical activity, using independently established values for the energy demands of each activity. In this analysis, "regular" physical activity (at the levels indicated) is defined as at least 15 minutes of leisure time physical activity 12 or more times per month. The NPHS and CCHS results apply to Canadians 12 and older.[20]

- Other surveys have assessed physical activity levels according to whether respondents reported exercising three or more times weekly, once or twice weekly, less than once weekly, or never.[21]

- Health Canada's 1998 publication, *Canada's Physical Activity Guide to Healthy Active Living*, calls for an hour of low-intensity activity every day, or 30-60 minutes of moderate-intensity activity, or 20-30 minutes of vigorous-intensity activity 4-7 days a week.[22] Only 34% of Canadians aged 25-55 currently meet these recommendations.[23]

- The Canadian Fitness and Lifestyle Research Institute's "physical activity profiles" rate Canadians according to whether their physical activity levels are sufficient for "optimal health benefits." Physical inactivity, according to this measure, is defined as less than 12.6 kilojoules (kJ)/kg of body weight per day of physical activity, the minimum judged necessary to obtain health benefits from physical activity.[24] The CFLRI results apply to Canadians 18

[20] Health Canada, *Statistical Report on the Health of Canadians,* 1999, Ottawa, page 189; Heart and Stroke Foundation of Canada, *The Changing Face of Heart Disease and Stroke in Canada 2000,* Ottawa, 1999, page 107; Chen, Jiajian, and Wayne J. Millar, "Health Effects of Physical Activity," Statistics Canada, *Health Reports* 11 (1), Summer, 1999, catalogue no. 82-003-XPB, pages 21-30, definitions on page 23.
[21] Statistics Canada, *CANSIM database,* Matrix #M1011.
[22] Health Canada, *Canada's Physical Activity Guide to Healthy Active Living,* Ottawa, 1998.
[23] Canadian Fitness and Lifestyle Research Institute, *Meeting Guidelines. Progress in Prevention Bulletin 31*, Ottawa, 1998, available at: http://www.cflri.ca/cflri/resources/pub_pip.php.
[24] Katzmarzyk, Peter, Norman Gledhill, and Roy Shephard, "The Economic Burden of Physical Inactivity in Canada," *Canadian Medical Association Journal* 163 (11), November 28, 2000, page 1437.

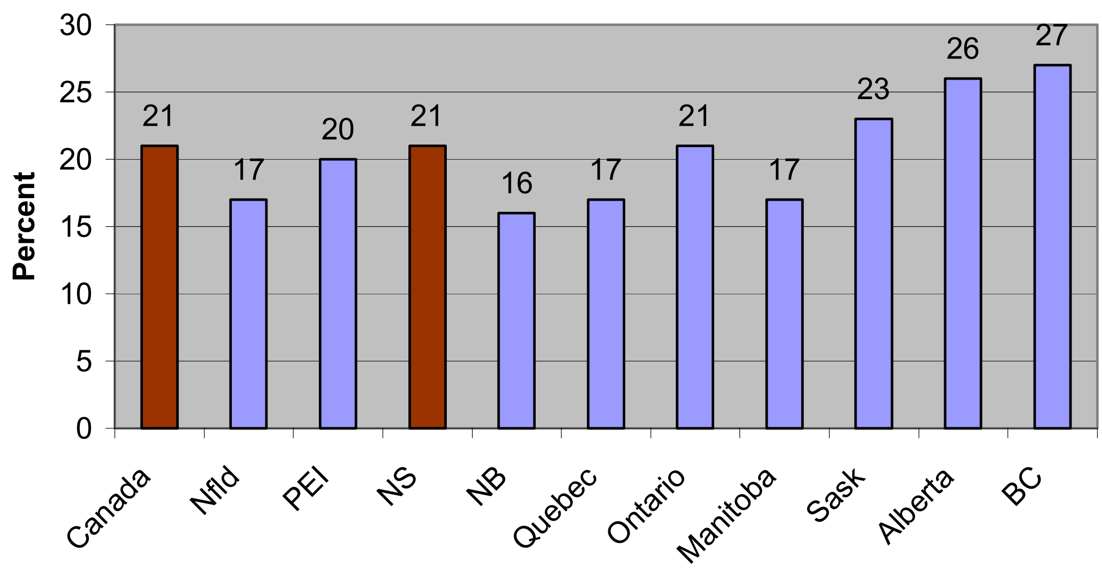
and older. The most recent 2000 Physical Activity Monitor Survey ranked 61% of Canadians and 62% of Nova Scotians as not active enough to reap the health benefits of a physically active lifestyle.[25]

- Because there are so many definitions of physical activity and inactivity, an "international consensus group" was formed in 1998 to develop an internationally agreed upon set of measures of physical activity participation. The group has now developed and pilot-tested a set of International Physical Activity Questionnaires (IPAQ), with Canada one of 12 countries participating in the validation and reliability phase of the project.[26]

2.2 Canadian Community Health Survey

According to Statistics Canada's 2000-2001Canadian Community Health Survey, only 21% of Nova Scotians and 21% of Canadians can be classified as physically active, expending 3.0 or more kilocalories of energy per kilogram of body weight per day. This compares to 27% of British Columbians (the most active in the country). Another 22% of Nova Scotians are moderately active (1.5-2.9 kcal/kg/day), and 53% are inactive (less than 1.5). By contrast, 49% of Canadians and 38% of British Columbians are inactive. Figure 2 demonstrates an east-west gradient, with eastern Canadians generally more inactive than westerners.[27]

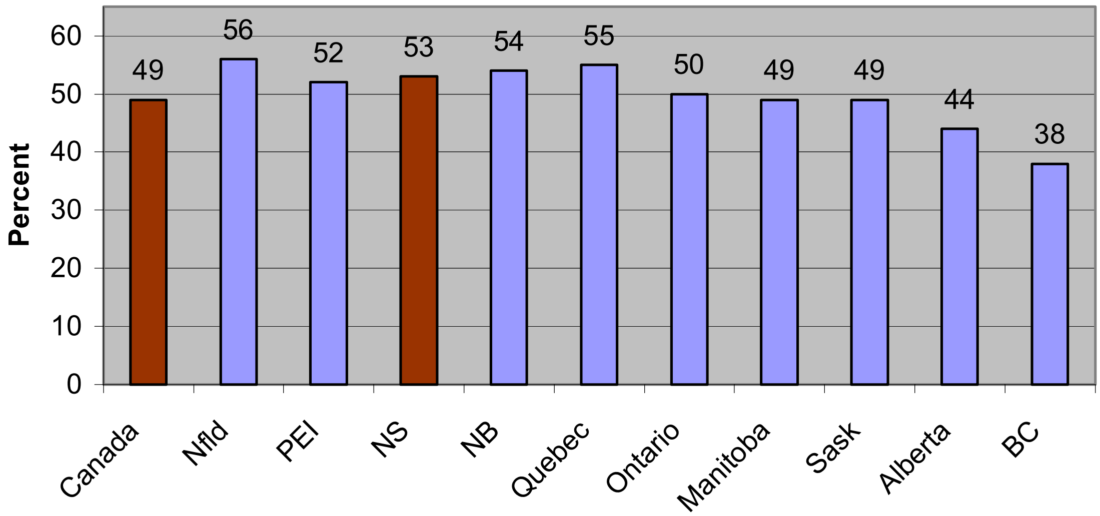
Figure 1: Physically Active Canadians (3.0 kcal/kg/day), Canada and Provinces, age 12+, 2000-2001 (Percent)



Source: Statistics Canada, *Health Indicators,* May 2002

[25] Canadian Fitness and Lifestyle Research Institute, *2000 Physical Activity Monitor,* available at: http://www.cflri.ca/cflri/pa/surveys/2000survey/2000survey.html.
[26] Canadian Fitness and Lifestyle Research Institute, *International Consensus Project on Physical Activity Measurement,* Ottawa, available at: http://www.cflri.ca/cflri/research/ipaq.html.
[27] Statistics Canada, *Health Indicators,* May 2002, catalogue no. 82-221-XIE

Figure 2: Inactive Canadians (less than 1.5 kcal/kg/day), Canada and Provinces, age 12+, 2000-2001 (percent)[28]



Source: Statistics Canada, *Health Indicators,* May 2002

2.3 Regular Exercise 1985-1996

Statistics Canada's *CANSIM* database provides information on trends over time for the number of Canadians who exercise regularly. The data indicate an increase in physical activity among Canadians as a whole, while the proportion of the population exercising regularly in Nova Scotia has remained stagnant. Fifteen years ago Maritimers were more physically active than most Canadians, exercising more frequently in their leisure time. Today all four Atlantic provinces rank significantly *below* the Canadian average (Figure 3).[29]

Interestingly, the averages conceal some important gender differences. Women have generally *increased* their rates of leisure time physical activity quite dramatically since 1985, by 24% in Newfoundland, 15% in Nova Scotia, and 8% in New Brunswick. Overall this is a good prognosis

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[28] Caution must be exercised in comparing CCHS and NPHS results, even though they use the same definition of physical inactivity. The most recent CCHS results, as reported in Statistics Canada's May 2002 *Health Indicators,* include a 5% "physical activity not stated" category for Nova Scotia that is not included in the 1996/97 NPHS results recorded in the *Statistical Report on the Health of Canadians.*

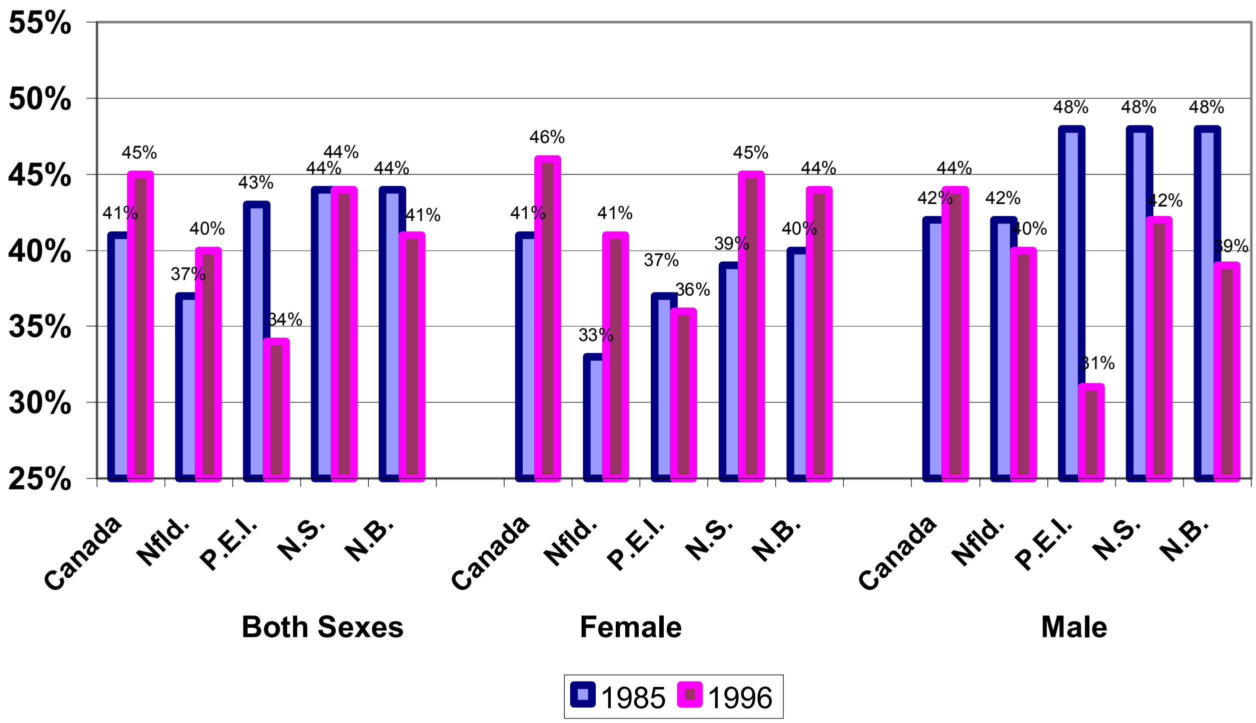
[29] Statistics Canada, *CANSIM Database* Matrix #M1011, Tables H501100 - H501212. Percentages calculated by the author using population figures for 1985 and 1996 from Statistics Canada, *CANSIM Database,* Matrices #M6367 - M6371 inclusive, and selected Tables from C892268 to C893542. In this, as in all provincial tables, caution must be exercised in interpreting trends for Prince Edward Island, as sample sizes are frequently small and produce a larger margin of error than for the other provinces.

for women's health in this region, and should help decrease the rate of cardiovascular disease and other chronic ailments among women.

By contrast, while more Canadian men than ever are exercising in other parts of the country, more Atlantic region males are becoming sedentary. In all four Atlantic provinces, there has been a dramatic decline in physical activity by men. By this measure, fully six out of ten Atlantic region men do not exercise regularly in their free time, with declines in male activity rates of 36% in P.E.I., 18% in New Brunswick, 13% in Nova Scotia, and 4% in Newfoundland. Fifteen years ago, in every Atlantic province, more men than women exercised on a regular basis, by a significant margin. Today, in every Atlantic province, more women exercise than men.

In the long term, the trends indicate that while Atlantic Canadian men had a relatively lower risk of heart disease in 1985 compared to other Canadians, they now have a significantly higher risk, the costs of which will gradually become evident over time.

.Figure 3: Persons Who Exercise, 1985 - 1996 (%)



Source: Statistics Canada, *CANSIM Database*

2.4 CFLRI: Physical Activity Monitor 2000

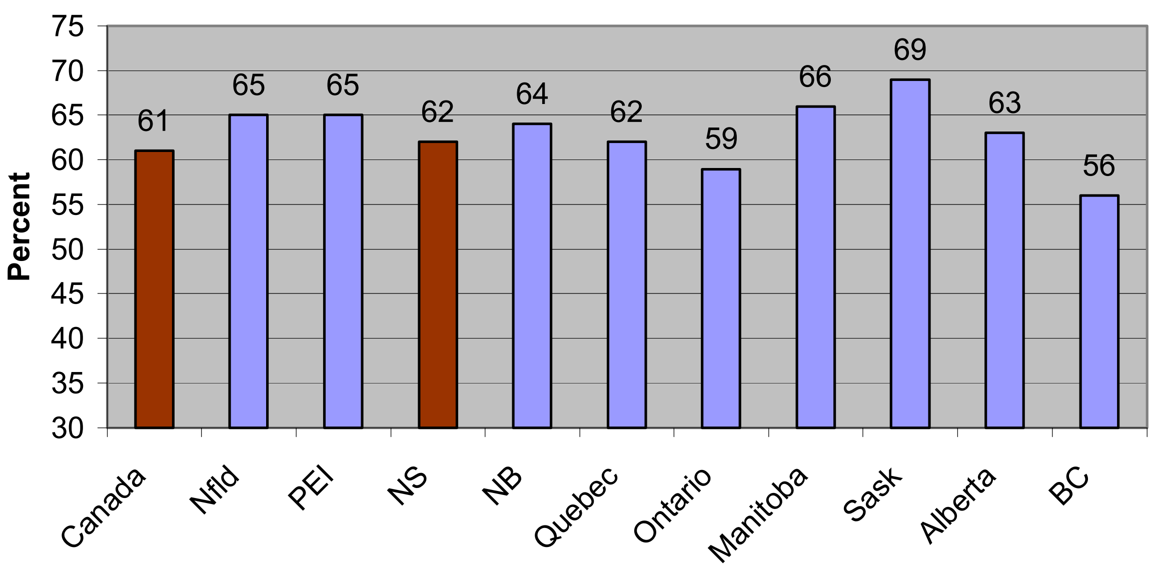
Since 1998, the Canadian Fitness and Lifestyle Research Institute (CFLRI) has produced provincial survey data on rates of physical activity and inactivity in Canada. Unlike the Statistics

Canada data on regular exercise above, the CFLRI data show rates of inactivity in Nova Scotia declining from 69% in 1998 to 65% in 1999 to 62% in 2000.

In Canada as a whole longer trend lines are possible, because nationwide data sets are available at irregular intervals since the first Canada Fitness Survey in 1981. They show considerable progress being made over 15 years, with physical inactivity rates falling from 79% in 1981 to 63% in 1995, and physical activity rates rising by an average of one percentage point each year, as awareness of the health benefits of physical activity spread. Since 1995, however, this progress has stalled, with little improvement since that time.[30]

Figure 4 below gives rates of physical inactivity in Canada from the CFLRI Physical Activity Monitor for 2000. A noted, these results are not comparable to those provided by the 2000/01 Canadian Community Health Survey (CCHS) in Figure 2 above. A similar gap between CFLRI and National Population Health Survey (NPHS) results is evident for earlier years. The 1996-97 CFLRI Physical Activity Monitor found that 66% of Canadians were not sufficiently active to reap the benefits of physical activity, while the NPHS data for those same years reported a physical inactivity rate of 57% for Canadians. The difference is due to the fact that CFLRI evaluation criteria are markedly different from those in the NPHS and CCHS, as noted in the discussion on definitions in section 2.1 above.

Figure 4: Percentage of Canadians insufficiently active for optimal health benefits, 2000



Source: Canadian Fitness and Lifestyle Research Institute, *2000 Physical Activity Monitor*

[30] Canadian Fitness and Lifestyle Research Centre, Physical Activity Monitors and Surveys, 1981-2000, available at: http://www.cflri.ca/cflri/pa/surveys/.

3. The Economic Cost of Physical Inactivity

3.1 Methodology

To estimate the economic costs of physical inactivity (or of any other risk factor) in Nova Scotia, the following steps are necessary:

1) The epidemiological evidence is examined to ascertain the relationship between physical inactivity and various diseases. This is expressed as the "relative risk" (RR) of developing a particular disease for a physically inactive person compared to an active person.[31] The relative risk is determined by dividing the rate of the disease among sedentary people by the rate of disease among active people. For example, if sedentary people are twice as likely to develop heart disease, then the relative risk (RR) is 2.

   In this case, the relative risks for seven chronic diseases, and the methodology for assessing the economic cost of physical inactivity, are taken from an analysis by Katzmarzyk, Gledhill, and Shephard in the *Canadian Medical Association Journal (CMAJ),* 28 November, 2000.[32] GPI Atlantic used the same method in early 2000, also based on a CMAJ analysis, to assess the cost of obesity in Nova Scotia.[33] To the best of our knowledge the November, 2000, CMAJ article is the first Canadian study to use previously published meta-analyses and large prospective epidemiological studies to estimate the relative risks attributable to physical inactivity for various chronic diseases. This now makes it possible, for the first time, to assess the economic cost of physical inactivity in Nova Scotia.

2) The second step is to ascertain the prevalence of a risk factor within a given population. Because the CMAJ article uses the Canadian Fitness and Lifestyle Research Institute's Physical Activity Monitoring Survey results (2.4 above), this analysis does the same in order to obtain comparable results and maintain the same methodology. However, the CMAJ article used 1997 survey results, while this Nova Scotia analysis uses the most recent 2000 results. Coincidentally, the 2000 Nova Scotia rate of physical inactivity (62%) is identical to the 1997 Canadian physical inactivity rate, so that the population attributable fraction of each disease is also identical. (see step 3 below.)

3) To assess the public health burden of sedentary living, or of any other risk factor, the relative risk (step 1) is combined with the absolute frequency of physical inactivity (or other risk factor) in the population. The resulting population attributable fraction (PAF) of a disease is an estimate of the effects of an individual risk factor on a given disease, and the extent to which each disease is attributable to the risk factor. The population attributable fraction

[31] Methodological explanation from Canadian Fitness and Lifestyle Research Institute (CFLRI) "The Burden of Inactivity," *The Research File ,* reference no. 98-01; "Health Care Savings," *The Research File,* reference no. 97-02; "An Economic Case for Physical Activity," *The Research File,* reference no. 95-03.
[32] Katzmarzyk, Peter, Norman Gledhill, and Roy Shephard, "The Economic Burden of Physical Inactivity in Canada," *Canadian Medical Association Journal,* 163 (11), November 28, 2000.
[33] Colman, Ronald, *The Cost of Obesity in Nova Scotia,* Halifax, March, 2000. That study used the methodology of C. Laird Birmingham et al., in the *Canadian Medical Association Journal* 160 (4), 23 February, 1999.

(PAF) of a disease is, therefore, the proportion of each chronic disease that could theoretically be prevented by eliminating physical inactivity.[34]

The population attributable fraction (PAF) for each disease is calculated as [P(RR – 1] / [1 + P(RR – 1)], where P is the prevalence of physical inactivity in the population (in this case 62%), and RR is the relative risk for the disease in an inactive person. The results from steps 1-3 are presented in Table 1 below.

4) The fourth step is to multiply the population attributable fraction (PAF) for each disease by the total cost of treating that particular disease, using Health Canada's *Economic Burden of Illness in Canada* (EBIC), which describes illness costs by diagnostic category. In other words, we estimate the direct health care costs of treating the particular diseases that are linked to physical inactivity by using the population attributable fraction (PAF) of each disease to estimate the fraction of those costs that are attributable to physical inactivity.

   This analysis is based on the basic methodology of Katzmarzyk et al. in assigning costs to particular diseases, but the costs are updated and adjusted for Nova Scotia specific data whenever possible. Katzmarzyk et al. used the 1993 EBIC results, inflated to 1999 values. In this analysis Nova Scotia specific results from the 1998 EBIC (scheduled for release in May, 2002) are used. Also, the provincial incidence of particular diseases is used wherever such data are available.

   Another difference is that this study includes a category of "other" direct costs, following the new 1998 EBIC classification. This includes costs for other institutions, home care, and a range of private medical expenditures, in addition to the four direct cost categories used in the 1993 EBIC (hospitals, drugs, physicians, and research). In assessing the costs of medical care attributable to physical inactivity as a percentage of total Nova Scotia health care expenditures, two estimates are therefore given in this report. The first is a percentage of total direct health care costs, public and private. The second reflects a percentage of the Nova Scotia taxpayer-funded health care budget (and thus excludes private expenditures and most "other" costs).

   Katzmarzyk et al. used costs specific to coronary heart disease and stroke from the 1993 EBIC. The 1998 EBIC does not yet provide Nova Scotia specific data for these illnesses separate from the broader category of cardiovascular diseases. Therefore, the proportion of heart disease and stroke as a percentage of total cardiovascular disease from the 1993 EBIC is applied to the provincial data from the 1998 EBIC. By this estimate coronary heart disease accounts for 28.2% of the direct health care costs for all cardiovascular diseases, and stroke accounts for 19.6% of cardiovascular disease direct costs. These overall percentages are used to estimate the "other" cost category. For hospital, drug, physician, and research costs, the 1993 EBIC estimates the proportion of total cardiovascular medical costs that are attributable to heart disease and stroke; and these percentages are then applied to the 1998 cardiovascular disease cost estimates for Nova Scotia, as indicated in the notes to Table 2 below.

[34] Methodological explanation from CFLRI, "The Burden of Inactivity" and "The Economic Case for Physical Activity," op. cit.; and Katzmarzyk et al., op. cit., page 1437.

The EBIC diabetes estimates are adjusted to account for the fact that type 2 diabetes constitutes 92.5% of diabetes cases. Again, the Nova Scotia specific cost estimates from the 1998 EBIC include diabetes in the endocrine and related disorders diagnostic category. In the 1993 EBIC, diabetes constituted 43.3% of all direct endocrine and related disorder health care costs, and type 2 diabetes would constitute 40.0% of costs for this diagnostic category.

Colon cancer and breast cancer costs are estimated in this report by using the incidence of these two cancers relative to all cancers in Nova Scotia, using the National Cancer Institute of Canada's *Canadian Cancer Statistics 2001.* Colorectal cancers account for 13.3% of all cancers in Nova Scotia. According to Katzmarzyk et al., colon cancers constitute 67.1% of total colorectal cancers, so that colon cancers would amount to about 8.9% of all cancer incidence in Nova Scotia. This is very close to the 8.6% estimate used by Katzmarzyk et al. for Canada. As Nova Scotia has the second highest rate of colorectal cancers in Canada, this slightly higher estimate makes sense. Breast cancer accounts for 12.7% of all cancers in Nova Scotia.

Hypertension costs are assessed relative to total cardiovascular disease costs according to the proportions used by Katzmarzyk et al., based on U.S. estimates. This assigns 5.7% of hospital costs attributable to cardiovascular diseases, 50.6% of drug costs, and 28.7% of physician costs to hypertension treatment. Because heart disease and stroke together account for less than 3% of all health science research in cardiovascular diseases, we have assigned 80% of cardiovascular research costs to hypertension. The total amount here is small, but this figure may require readjustment as new evidence becomes available. For other direct costs, including other institutions, home care and a range of private medical expenditures, we arbitrarily use the average of the hospital, drug, and physician percentages given here – namely, 28.3% of the other direct health care costs attributable to cardiovascular diseases are assigned to hypertension treatment.

Osteoporosis costs are not separated out in the EBIC from the general musculoskeletal disease diagnostic category. Katzmarzyk et al. therefore use an independent assessment of the burden of illness due to osteoporosis in Canada, pegged at $1.3 billion annually. For this disease, we assign costs according to the Nova Scotian proportion of the Canadian population, on the assumption that the prevalence of osteoporosis is similar.

5) Indirect productivity losses due to premature mortality and disability for each of these diseases are estimated as follows. For coronary heart disease, stroke, and diabetes, the ratio of indirect to direct costs from the 1993 EBIC is applied to the direct cost estimates in Table 3 below. Costs for those more specific diagnostic categories are given in the 1993 EBIC but are not yet available at the provincial level in the forthcoming 1998 EBIC results. For colon cancer and breast cancer, the ratio of indirect to direct costs for all cancers in Nova Scotia is used from the 1998 EBIC.

   Similarly, since productivity losses due to hypertension were not separately available, the ratio of indirect to direct costs for all cardiovascular disease in Nova Scotia is used from the 1998 EBIC. Likewise, productivity losses due to osteoporosis are estimated by using the ratio between indirect and direct costs for all musculoskeletal disorders in Nova Scotia from the

1998 EBIC. Katzmarzyk et al. did not attempt estimates of these wider economic losses, but they have been included in this study, just as they were in earlier GPI Atlantic estimates of the costs of obesity and tobacco in Nova Scotia.

6) An important category of illness related to physical inactivity has been omitted in the Katzmarzyk et al. cost estimates – namely mental illness. As noted above, Statistics Canada has estimated that sedentary Canadians are 60% more likely to suffer from depression than physically active Canadians. Physical activity also protects against stress, which has been assessed in meta-analyses of medical costs as the most expensive risk factor, accounting for about 8% of health care costs.[35] For this reason, a rough estimate is added in this study, based on the 1998 EBIC figures for Nova Scotia, of the possible costs of mental illness attributable to physical inactivity in the province. Although it is not possible at this stage to derive an accurate population attributable fraction (PAF) for mental illness in relation to physical inactivity, it is considered more accurate to attempt an estimate for this category than to assign it an arbitrary value of zero.

   Other cost estimates omitted by Katzmarzyk et al. relate to association of physical activity with dyslipidemia, poorer quality of life, and premature admission to an institution or geriatric care. No attempt has been made here to provide cost estimates for these conditions or situations. Some costs of physical inactivity related to obesity are also omitted. Since obesity is linked to diseases such as gallbladder disease and pulmonary embolism in addition to those described here, physical inactivity may indirectly contribute to ailments that are not included in the costs estimates in Table 2 below.

7) The number of premature deaths attributable to physical inactivity in Nova Scotia is estimated by multiplying the number of deaths attributable to each inactivity-related disease by the population attributable fraction (PAF) for that disease. Deaths from heart disease and stroke in Nova Scotia are taken from Health Canada's *Statistical Report on the Health of Canadians.* Deaths from colon cancer and breast cancer in Nova Scotia are from the National Cancer Institute of Canada's *Canadian Cancer Statistics 2001,* taking 67.1% of the colorectal cancer mortality figures for colon cancer deaths, as described above. Deaths due to diabetes, hypertension, and osteoporosis are derived from Katzmarzyk et al., and assume the same proportion of deaths due to these three conditions in Nova Scotia, as a percentage of total physical inactivity related deaths, as in Canada. A similar method is used to estimate potential years of life lost due to physical inactivity.

8) Finally, the savings that could potentially be realized from a 10% reduction in physical inactivity are derived from the estimates of Katzmarzyk et al. who recalculated the population attributable fractions (PAF) of each disease and corresponding costs by assuming a 56% prevalence of inactivity instead of a 62% prevalence. Katzmarzyk and his colleagues then estimated savings according to the difference between the two sets of costs. The 56% prevalence is 62% minus 6.2% (representing a 10% reduction in physical inactivity). As the current Nova Scotia physical inactivity rate (62%) is identical to that used by Katzmarzyk et

[35] Aldana, Steven, "Financial Impact of Health Promotion Programs: A Comprehensive Review of the Literature," in Goetzel, Ron, (ed.) "The Financial Impact of Health Promotion," *American Journal of Health Promotion* 15 (5), May/June, 2001.

al. for Canada in 1997, the Nova Scotia savings are assumed to be proportional to the results derived by Katzmarzyk et al.

3.2 Direct Costs of Physical Inactivity, Nova Scotia

Table 1 gives the relative risk (RR) estimates for each of seven chronic diseases that have been associated with physical inactivity, based on epidemiological studies reviewed by Katzmarzyk et al., and the population attributable fractions for each disease based on Nova Scotia's physical inactivity prevalence rate of 62%. This table corresponds with Table 2 in Katzmarzyk et al (CMAJ 163 (11), page 1437).

A relative risk of 1.9 for coronary heart disease (or coronary artery disease as it is also called) means that physically inactive people have a 90% greater chance of having that disease than those who are physically active. As noted above, this is a conservative estimate by comparison with the Statistics Canada analysis of National Population Health Survey results reported above. The bracketed numbers following the relative risk ratios represent the possible range of results based on a 95% confidence interval (CI).

A population attributable fraction (PAF) of 35.8% for heart disease means that more than one-third of heart disease in Nova Scotia could be avoided if all Nova Scotians were physically active. This is higher than the 22% estimate for the U.S. reported above. Table 1 also indicates that about 20% of stroke, hypertension, colon cancer, and type 2 diabetes, as well as 27% of osteoporosis and 11% of breast cancer, could be eliminated if Nova Scotians who are presently sedentary became physically active.

The most likely explanation for the differences in population attributable fractions (PAF) between these results and those reported earlier for the U.S., is that different methods are used to estimate prevalence of inactivity. Some of these differences are noted in the discussion of definitions in 2.1 above. The relative risk ratios do not differ markedly, and U.S. studies are included in the epidemiological meta-analyses conducted both by Colditz at the Harvard Medical School and by Katzmarzyk and his colleagues. But the method of assessing inactivity prevalence will produce markedly different population attributable fractions (PAF) for each disease.

It has not been possible in this study to conduct sensitivity analyses based on alternative methods of assessing physical inactivity prevalence, but Katzmarzyk and his colleagues did perform sensitivity analyses that varied each population attributable fraction (PAF) and disease-specific health care cost by 20% above and below the mean estimate. That range is also presented in this study, but GPI Atlantic suggests that the lower range may be more accurate, since it does appear that the Canadian Fitness and Lifestyle Research Institute standard, on which the 62% inactivity rate used in this study is based, is a fairly high standard.

The disparity between the Nova Scotia results in the 2000-2001 Canadian Community Health Survey (CCHS), and in the 2000 Canadian Fitness and Lifestyle Research Institute Physical Activity Monitor, demonstrates the variance in standards. The 2000 CFLRI results for Nova

Scotia show a 62% inactivity rate, whereas the CCHS results for 2000/01, how a 53% inactivity rate.[36]

Based on this comparison, the CFLRI standard therefore indicates a potential 17% higher rate of physical inactivity than would be derived using the NPHS / CCHS standard of <1.5kcal/kg/day (see section 2.1 above.) Using the NPHS / CCHS standard would therefore produce lower population attributable fractions (PAF) for each disease, more in line with the U.S. figures, and would also produce correspondingly lower medical cost estimates. In short, the cost estimates below are very sensitive to the particular definitions of physical inactivity employed.

Table 1: Relative risk and population attributable fraction due to physical inactivity for major chronic diseases, Nova Scotia, 2000.

Disease	RR (and 95% CI)	PAF (%)
Coronary heart disease	1.9 (1.6 – 2.2)	35.8
Stroke	1.4 (1.2 – 1.5)	19.9
Hypertension	1.4 (1.2 – 1.6)	19.9
Colon cancer	1.4 (1.3 – 1.5)	19.9
Breast cancer	1.2 (1.0 – 1.5)	11.0
Type 2 diabetes	1.4 (1.2 – 1.6)	19.9
Osteoporosis	1.6 (1.2 – 2.2)	27.1

Note: Based on a prevalence of physical inactivity of 62% in Nova Scotia in 2000 according to the Canadian Fitness and Lifestyle Research Institute
Source: Katzmarzyk et al., *Canadian Medical Association Journal* 163 (11), Nov. 28, 2000, page 1437.

Even though these relative risk (RR) and population attributable fraction (PAF) estimates reported by Katzmarzyk and his colleagues in the *Canadian Medical Association Journal* differ from some of the U.S. results reported earlier, theirs is the first Canadian effort to derive medical care costs attributable to physical inactivity. For this reason we have used the relative risk and population attributable fraction (PAF) estimates reported by Katzmarzyk et al. in Table 1 above, and applied these to the Nova Scotia cost estimates in Table 2 below.

Table 2 presents estimated direct health care costs attributable to physical inactivity in Nova Scotia. About $94.7 million are spent annually in direct health care costs due to physical inactivity. Theoretically, this is the annual amount that could be saved if all Nova Scotians were physically active. Physical inactivity accounts for 25% of the total costs of treating heart disease, stroke, hypertension, colon cancer, breast cancer, diabetes 2, and osteoporosis in Nova Scotia.

[36] Caution must also be exercised in comparing CCHS and NPHS results, even though they use the same definition of physical inactivity. The most recent CCHS results, as reported in Statistics Canada's May 2002 *Health Indicators,* include a 5% "physical activity not stated" category for Nova Scotia that is not included in the 1996/97 NPHS results recorded in the *Statistical Report on the Health of Canadians.*

Table 2: Health Care Costs for Chronic Diseases Linked to Physical Inactivity in Nova Scotia 1998 (2001$ thousands), and estimated direct economic cost of physical inactivity

	Hosp.	Doctor	Drugs	Research	Other [37]	Total[38] Direct	Direct cost due to inactivity
Heart Disease[39]	52,183	8,053	9,721	17	38,849	108,823	**38,958**
Stroke[40]	41,795	2,286	4,535	6	27,001	75,624	**15,049**
Hypertension	9,208	7,628	32,187	647	38,986	88,657	**17,643**
Colon cancer	6,352	1,047	671	8	4,415	12,493	**2,486**
Breast cancer	9,067	1,495	958	11	6,300	17,827	**1,961**
Type 2 diabetes	7,407	2,869	11,744	137	12,026	34,183	**6,802**
Osteoporosis	NA	NA	NA	NA	NA	43,690	**11,840**
Total						381,298	**94,739**

Sources: Katzmarzyk et al., *Canadian Medical Association Journal;* Health Canada, *The Economic Burden of Illness in Canada 1998* (forthcoming May, 2002); Health Canada, *Statistical Report on the Health of Canadians;* National Cancer Institute of Canada, *Canadian Cancer Statistics 2001;* Health Canada, *The Economic Burden of Illness 1993* (for derivations of ratios of heart disease and stroke costs to total circulatory disease costs; and of diabetes costs to total endocrine disorder costs.)

The $94.7 million cost estimate includes private spending on medical care, which includes spending on institutions other than hospitals, and on home care. Looking only at hospital, physician and drug costs, total spending attributable to the seven chronic illnesses in Table 2 is $235 million.[41] Applying the population attributable fractions from Table 1 for these seven illnesses, physical inactivity would account for $58.4 million in hospital, physician and drug costs. This amounts to 3.6% of total spending on hospitals, physicians, and drugs in Nova Scotia

[37] Hospital, physician, drug, and research costs are currently available for Nova Scotia by diagnostic category. However, at the present time, other direct health care costs in Nova Scotia, including private spending for other institutions and home care, are available only for all illness categories combined. These additional direct costs are therefore extrapolated here for the separate diagnostic categories, on the assumption that they occupy the same proportion of total direct health care costs for each diagnostic category separately as they do for all health expenditures combined. More precise information on these other costs may become available later this year, when the electronic version of *The Economic Burden of Illness in Canada 1998 (EBIC 1998)* is released. If provincial information on other costs is not provided at that stage, other costs by diagnostic category at the provincial level can be extrapolated from national data on the ratio of other costs to total health care costs by diagnostic category. In the meantime, the absence of direct information for this column should not substantially affect the total results, since the figures given here do reflect the actual proportional breakdown for all diagnostic categories for the province.

[38] "Total" refers to hospital, physician, drug, and health science research costs plus other medical expenses, including privately funded services, home care, and costs of other institutions.

[39] According to the 1993 EBIC, coronary heart disease accounts for 32.3% of hospital costs attributable to cardiovascular diseases; and 30.3% of physician costs; 15.3% of drug costs; and 2.2% of research costs attributable to cardiovascular diseases (Health Canada, *Economic Burden of Illness in Canada 1993,* Ottawa, 1997, table 2, page 10). These percentages are applied to the 1998 EBIC figures for Nova Scotia (forthcoming, May, 2002).

[40] According to the 1993 EBIC, stroke accounts for 25.9% of hospital costs attributable to cardiovascular diseases; and 8.6% of physician costs; 7.1% of drug costs; and 0.8% of research costs attributable to cardiovascular diseases. These percentages are applied to the 1998 EBIC figures for Nova Scotia.

[41] Though not separately available, osteoporosis costs for hospitals, drugs, and physicians are attributed here in the same proportion as for all direct health care costs.

in 1998. If this percentage is applied to a total provincial health care budget of $1.9 billion, it indicates that physical inactivity costs the taxpayer-funded Nova Scotia health care system about $68.7 million annually. [42]

Paradoxically, these direct expenditures on hospitals, doctors, drugs and other medical services are conventionally counted in the Gross Domestic Product (GDP) and related economic growth statistics, and are therefore mistakenly taken as contributions to prosperity and wellbeing. In the Genuine Progress Index, by contrast, the $94.5 million in health care costs attributable to physical inactivity is counted as a cost, not a gain to the economy. If all Nova Scotians were physically active, the $94.5 million would presumably be available to be spent on more productive activities, including sport and recreation, that contribute to wellbeing.

Katzmarzyk et al. conducted sensitivity analyses that varied each population attributable fraction (PAF) and disease-specific health care cost by 20% above and below the mean estimate. This exercise has not been repeated here. But if the results of Katzmarzyk et al. are applied to the estimates in Table 2, then the direct health care costs attributable to physical inactivity could be as low as $63 million or as high as $130.3 million. As noted above, the Canadian Fitness and Lifestyle Research Institute standard is higher than that used in the Canadian Community Health Survey to define physical inactivity. Applying the CCHS standard would lead to a cost estimate of about $81 million attributable to physical inactivity, rather than the $94.7 million estimate given here.

3.2.1 Accounting for Mental Health Costs due to Physical Inactivity

Katzmarzyk and his colleagues omit estimates of mental illness costs attributable to physical inactivity. As noted above, Statistics Canada estimates, based on the 1996-97 National Population Health Survey results, indicate that sedentary Canadians are 60% more likely to suffer from depression than physically active Canadians. Physical activity also protects against stress and anxiety.

Mental illness costs Nova Scotia $249.2 million in direct health care expenditures.[43] If just 5% of these costs could be avoided through physical activity that reduces the incidence of depression, anxiety, and stress, then $12.5 million a year in mental health care costs might be ascribed to physical inactivity. Including mental illness costs therefore raises the estimate of total direct health expenditures due to physical inactivity in Nova Scotia from $94.7 million to $107 million annually.

Similarly, if 5% of the $160 million currently expended on treating mental health through hospitals, drugs, and physician services can be attributed to physical inactivity, then physical inactivity would account for a total of $66.5 million in hospital, drug, and physician costs. This

[42] Note that this $68.7 million estimate applies only to taxpayer funded health-care costs, whereas the $94.7 million total in Table 2 below includes private health care expenditures.
[43] Colman, Ronald, *The Cost of Chronic Illness in Nova Scotia,* forthcoming, GPI Atlantic, Halifax, 2002, based on 1998 EBIC estimates for Nova Scotia.

amounts to 4% of total provincial spending on hospitals, drugs, and doctors that can be attributed to physical inactivity.

It must be emphasized that population attributable fractions for mental ailments like depression, anxiety, and stress were not available for this study, and the 5% attribution here is an arbitrary, if conservative, estimate. However, since mental health has been reliably linked to physical activity, it is more accurate to include some estimate of mental illness costs due to physical inactivity than to assign such costs an arbitrary value of zero, which is implied by omitting the diagnostic category entirely.

3.3 Indirect Costs of Physical Inactivity, Nova Scotia

Table 3 adds estimates for indirect productivity losses due to premature mortality and disability for each of the diseases that are related to physical inactivity. Productivity losses due to premature mortality are estimated according to the ratio of indirect to direct costs from the 1993 EBIC for heart disease, stroke, and diabetes. For heart disease, productivity losses due to disability are also according to the ratios provided in the 1993 EBIC.

For stroke, the 1993 EBIC provides estimates of productivity losses due to premature death, but not due to disability. The latter are therefore extrapolated from the 1998 EBIC for Nova Scotia, according to the following reasoning. Productivity losses due to premature death as a result of coronary heart disease account for 62% of all premature death costs due to all cardiovascular diseases. By contrast, heart disease accounts for just 28% of direct costs for all cardiovascular diseases, and just 15% of all indirect costs due to disability resulting from all cardiovascular diseases. In other words, a disproportionately high share of total heart disease costs result from premature death. Stroke would therefore occupy a correspondingly smaller proportion of productivity losses due to premature death resulting from all cardiovascular diseases and a correspondingly larger proportion of productivity losses due to disability. The estimates in Table 3 reflect these assumptions and are extrapolated from the totals provided for all cardiovascular diseases in the EBIC.

Disability costs due to diabetes are estimated using the ratio of productivity losses due to disability to productivity losses due to premature death for all endocrine diseases (from the 1998 EBIC for Nova Scotia). For the other illnesses, indirect costs due to productivity losses are estimated according to the ratio of indirect to direct costs from the 1998 EBIC results for Nova Scotia for cardiovascular diseases (for hypertension), for all cancers (for colon cancer and breast cancer) and for musculoskeletal disorders (for osteoporosis). For the latter three diseases, the ratio of productivity losses due to premature death and due to disability are extrapolated from the totals for all cancers and for all musculoskeletal disorders. For hypertension, a total indirect cost estimate is given without any attempt to make this distinction, the assumption being that indirect costs due to hypertension are likely due to disability losses.

Table 3 indicates clearly that the greatest costs of chronic illness are due to the premature death and disability they produce, resulting in substantial productivity losses to the economy. Physical inactivity is responsible for $241 million annually in productivity losses. In other words, the

Nova Scotia economy would be worth $241 million more each year than it currently is if it had the productive services of the hundreds of Nova Scotians disabled or killed prematurely by a sedentary lifestyle. When direct medical costs and economic productivity losses are added, Table 3 shows that the total economic burden of physical activity to Nova Scotia exceeds $322 million annually.

Table 3: Productivity Losses due to Physical Inactivity (2001$ thousands), and Total Economic Costs of Physical Inactivity in Nova Scotia, 1998

	Direct Costs (Table 2)	Premature death	Disability	Total Indirect Costs	Total economic cost of physical inactivity
Heart Disease	**38,958**	86,262	13,060	99,321	**138,280**
Stroke	**15,049**	12,762	50,999	63,761	**78,811**
Hypertension	**17,643**	29,669		29,669	**47,312**
Colon cancer	**2,486**	7,568	257	7,824	**10,310**
Breast cancer	**1,961**	5,968	202	6,170	**8,130**
Type 2 diabetes	**6,802**	6,592	4,054	10,646	**17,448**
Osteoporosis	**11,840**	276	23,917	24,193	**36,033**
Total	**94,739**			**241,586**	**336,324**

Sources: Table 2 above, and Health Canada, *The Economic Burden of Illness in Canada,* 1993 and 1998.

Productivity losses due to mental illness that is attributable to physical inactivity would add an estimated $4.4 million to the indirect costs in Table 3, again on the assumption that 5% of mental illness could be avoided through physical activity.[44] Added to the estimated $12.5million in direct health care expenditures on mental illness that can be attributed to physical inactivity, the total economic cost of physical inactivity in Nova Scotia can be estimated at $353 million annually.

3.4 Premature Deaths due to Physical Inactivity in Nova Scotia

The indirect costs and productivity losses due to premature death in section 3.3 above are a function of two variables:

1) the number of premature deaths attributable to each diagnostic category that could have been avoided if all Nova Scotians were physically active; and
2) age at death, which determines the potential years of life lost due to physical inactivity.

Table 4 identifies the first of these two variables explicitly by applying the population attributable fractions for physical inactivity to five key illnesses. Osteoporosis and hypertension

[44] Based on 1998 EBIC estimates for Nova Scotia.

are not included in this estimate because they are rarely direct causes of death, but are rather implicated in other causes of death. For example, an osteoporotic fracture can result from a fall, but the consequent death may be reported as due to injury rather than to osteoporosis, which is the underlying cause.

Heart disease and stroke deaths in Table 4 are from Health Canada's 1999 *Statistical Report on the Health of Canadians;* colon and breast cancer deaths are based on the National Cancer Institute of Canada's *Canadian Cancer Statistics 2001;* and diabetes deaths are extrapolated to Nova Scotia from U.S. data reported by the U.S. Centers for Disease Control. Table 4 is based on Table 4 in Katzmarzyk et al., *Canadian Medical Association Journal* 163 (11), page 1438.

Table 4 shows that if all Nova Scotians were physically active, life expectancy could be increased in the province, and 711 premature deaths could be avoided each year. This is 9.2% of all deaths among Nova Scotians.

Table 4: Number of Deaths Attributable to Physical Inactivity, Nova Scotia

Disease	**# of deaths**	**% of total NS deaths**	**Deaths attributable to physical inactivity**	**% of deaths attributable to physical inactivity (=PAF)**
Heart disease	1,504	19.4%	534	35.5%
Stroke	504	6.5%	100	19.9%
Colon cancer	134	1.7%	27	19.9%
Breast cancer	200	2.6%	22	11.0%
Diabetes 2 [45]	139	1.8%	28	19.9%
All causes	7,751	100%	**711**	**9.2%**

Sources: Katzmarzyk et al., *Canadian Medical Association Journal* 163 (11), page 1438; Health Canada, *Statistical Report on the Health of Canadians,* page 291; National Cancer Institute of Canada, *Canadian Cancer Statistics 2001,* page 27; U.S. Centers for Disease Control and Prevention "Chronic Diseases and Their Risk Factors: The Nation's Leading Causes of Death," Atlanta, 1999, page 34.

Katzmarzyk and his colleagues attribute 10.3% of all premature deaths in Canada to physical inactivity, and state that we could theoretically save 21,340 Canadian lives that are lost prematurely each year if all Canadians were physically active. Proportionately, this is a slightly higher estimate than the one in Table 4 above. The difference is due to the fact that different data sources were used for death statistics, and that Katzmarzyk and his colleagues based their estimate on total *adult* deaths, while Table 4 above is based on total Nova Scotian deaths, regardless of age.

[45] Based on U.S. data, there are estimated to be 150 deaths in Nova Scotia each year that are directly attributable to diabetes, but diabetes is a contributing cause to about 300 more deaths annually. Because it is a complicating factor in other serious illnesses, diabetes is frequently under-reported as the cause of death on death certificates. The estimate in Table 4 counts only those deaths directly attributable to diabetes 2, accounting for the fact that type 2 diabetes accounts for 92.5% of all diabetes cases.

Table 5 estimates the potential years of life lost annually due to physical inactivity. These estimates take into account both the number of deaths and the average age of death attributable to various illnesses. Health Canada's *Statistical Report on the Health of Canadians* considers deaths before age 70 as "early" deaths, and it counts the difference between these early deaths and age 70 as potential years of life that have been lost.[46]

Potential years of life lost due to heart disease, stroke, and cancer are taken from Health Canada's *Statistical Report on the Health of Canadians.* Potential years of life lost due to colon cancer and breast cancer are assumed here to be the same as for all cancers.

Comparable estimates for diabetes were not available at time of publication. Health Canada reports that "approximately 25,000 potential years of life lost (PYLL) were lost as a result of diabetes prior to age 75 in 1996,"[47] signifying an average of 4.6 years lost per death. However, it has not been possible to convert this figure to the 70-year age baseline at this time, and an extrapolated estimate is therefore provided here. Since heart disease is the most frequent cause of death among people with diabetes, the average years of life lost prior to age 70 per heart disease death (3.5 years) is also used here for diabetes.[48]

Table 5 shows that Nova Scotians each year lose about 2,200 potential years of life due to physical inactivity. This constitutes 6.5% of all potential years of life lost each year in the province due to all causes. If all Nova Scotians were physically active, society and the economy would benefit from an additional 2,200 productive person-years each year. It should be noted that this is a conservative estimate, as the average life expectancy for Nova Scotians is 78 years. If years of life lost were assessed against this average, the loss would be very much larger.

Table 5: Potential Years of Life Lost (PYLL) due to Physical Inactivity, Nova Scotia

Disease	PYLL	% of total NS PYLL	PYLL attributable to physical inactivity	% of PYLL attributable to physical inactivity (=PAF)
Heart disease	5,257	15.4%	1,866	35.5%
Stroke	573	1.7%	114	19.9%
Colon cancer	332	1.0%	66	19.9%
Breast cancer	734	2.1%	81	11.0%
Diabetes 2	487	1.4%	97	19.9%
All causes	34,235	100%	**2,224**	**6.5%**

Sources: Health Canada, *Statistical Report on the Health of Canadians,* page 321; National Cancer Institute of Canada, *Canadian Cancer Statistics 2001,* page 28.

46 Health Canada, *Statistical Report on the Health of Canadians,* page 319.
47 Health Canada, "Diabetes in Canada," available at http://www.hc-sc.gc.ca/hpb/lcdc/publicat/diabet99/d02_e.html.
48 Health Canada, *Statistical Report on the Health of Canadians,* pages 291 and 321.

3.5 Potential Savings from Higher Rates of Physical Activity

Katzmarzyk and his colleagues, in the *Canadian Medical Association Journal,* recalculated the direct health care costs attributable to physical inactivity with a reduction of 10% in the prevalence of inactivity. That is, they assumed the rate of physical inactivity to be 56% of the adult population instead of the current rate of 62%. This is in line with the 1996 public health objective proclaimed by Canadian federal, provincial, and territorial governments to achieve a 10% reduction in physical inactivity by 2003.[49]

Katzmarzyk et al. found that a 10% reduction in physical inactivity would reduce health care costs attributable to physical inactivity by 7%, resulting in health care savings of $161 million nationwide. Applying the same percentage saving to the Nova Scotia cost estimates above (including mental health) yields estimates of savings as follows[50]:

- Hospital, physician, and drug costs — $4.6 million less per year
- Total direct health care costs — $7.5 million less per year
- Economic productivity gains (avoided early death and disability) — $17.2 million
- Total annual economic savings — $24.7 million

A 10% reduction in physical inactivity could also save 50 lives a year in Nova Scotia, and avoid 156 potential years of life lost annually.

Needless to say, even a 56% rate of physical inactivity is very high. Smoking is still regarded as a major avoidable health problem even with a prevalence rate half as high as that of physical inactivity. Therefore, the potential for far more substantial long-term savings through promotion of sports, exercise, and recreation is very large indeed.

Katzmarzyk and his colleagues conclude their *Canadian Medical Association Journal* analysis with a strong recommendation:

> *"Given the considerable efforts that have been aimed at curbing the prevalence of smoking in Canada, public health campaigns directed at increasing physical activity in the population should be no less aggressive and persistent."*[51]

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[49] Health Canada, Federal, Provincial and Territorial Fitness and Recreation Committee, *Physical Inactivity: A Framework for Action,* Ottawa, 1996.

[50] These savings are not realized immediately following a reduction in inactivity, because the benefits of regular exercise accrue gradually.

[51] Katzmarzyk et al., op. cit., page 1439.