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MEASURING SUSTAINABLE DEVELOPMENT

APPLICATION OF THE GENUINE PROGRESS INDEX TO NOVA SCOTIA

THE COST OF PHYSICAL INACTIVITY *in* HALIFAX REGIONAL MUNICIPALITY

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For:

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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. Evidence indicates that in Halifax Regional Municipality 30% of heart disease, 22% of osteoporosis, 16% of stroke, hypertension, type 2 diabetes, and colon cancer, and 9% 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.

Urban planning offers excellent opportunities to increase chances for physical activity of residents by making walking or cycling viable alternatives to motorized transportation and by providing access to sports and recreation facilities. A recent study conducted in Atlanta, Georgia, found that walkability and connectedness of neighbourhoods are strongly associated with a decrease in the risk of obesity, while increased time spent in a car is associated with increasing risk of obesity.

According to the Canadian Community Health Survey, 48% of Halifax Regional Municipality (HRM) residents, 50% of Nova Scotians, and 47% of Canadians were physically inactive in 2003. HRM has the lowest rate of inactivity for any of the Nova Scotia statistical health regions, two of which have rates of inactivity of 54% (the South-SW Nova Scotia region and the Pictou-Guysborough-Antigonish-Strait region).

The evidence is clear that increased physical activity would save the province millions of dollars a year in avoided health care costs. It is estimated that physical inactivity in HRM costs the provincial health care system $16 million a year in hospital, physician and drug costs alone. When all direct health care costs are added, including private expenditures, the sedentary lifestyle of nearly half of HRM residents costs the province, and therefore the taxpayer, $23.6 million a year in direct medical care expenditures. It should be noted that these cost estimates are quite conservative since they are based on the less stringent guidelines for physical inactivity now used by the Canadian Community Health Survey (resulting in a 50% rate of inactivity for HRM as compared with the 62% rate of earlier studies) and also the costs of mental health due to disorders related to physical inactivity are not included.

This spending is currently added to the provincial Gross Domestic Product and economic growth statistics, and is thus 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 in HRM costs the provincial economy an additional $ 44.7 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 HRM is estimated at over $68 million annually. This amounts to $180 per person per year in Halifax Regional Municipality.

Two hundred HRM residents die prematurely each year due to physical inactivity, accounting for 7% of all premature deaths in the municipality. These premature deaths result in the loss of 850 potential years of life every year in HRM before age 70. In other words, if all HRM residents were physically active, the municipality would gain 850 productive years of life each year, with corresponding gains to the economy.

An increase in the rate of physical activity could save the province millions of dollars. If just 10% fewer residents of HRM over the age of 12 were physically inactive, the rate of physical inactivity would be 43.2% (10% of 48 is 4.8%, subtracted from 48% = 43.2). With this lower rate of physical inactivity, the province could save an estimated $1 million every year in avoided hospital, drug, and physician costs, and $1.65 million in total health care spending. Added to an estimated $3.1 million in productivity gains, total economic savings from a 10% reduction in physical inactivity amount to $4.75 million.

Given the enormous health care burden of a sedentary lifestyle, a regional plan in HRM that provides for safe and walkable communities, sidewalks and biking paths, as well as access to quality sport and recreation programs and facilities, has the potential to reduce the enormous human and economic burden of physical inactivity, and to improve the health of HRM residents.

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Introduction

This study was undertaken at the request of the Heart and Stroke Foundation of Nova Scotia in order to provide information on the true costs of physical inactivity in Halifax Regional Municipality (HRM), and to assist the municipality in its current long-term planning process. Assessing the full costs of physical inactivity provides a yardstick against which to measure the costs and benefits of various measures that would increase physical activity. HRM has shown forward vision in integrating environmental, health, social, and economic dimensions into its planning process. Increased opportunity for physical activity is a criterion that is woven into many aspects of the proposed development alternatives. However, some of these alternatives provide HRM with more capacity to support physical activity than others. The Heart and Stroke Foundation of Nova Scotia wishes to assist efforts to maximize opportunities for physical activity by providing needed data to determine their true cost effectiveness.

1. Physical Activity and Health

> "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] According to a study on healthy aging, "*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]

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[1] Canadian Fitness and Lifestyle Research Institute 2000. *The Research File,* 2000, Reference No. 00-01.
[2] National Center for Chronic Disease Prevention and Health Promotion, 2001. 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 2000. *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 2001. Promoting Health and Function in an Ageing Population, *British Medical Journal* 322 (7288), 24 March, 2001, pages 728-729.
[6] Fries, James 1996. 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.

According to Dr. Bruce Reeder,

> "The Heart and Stroke Foundation (of Canada) recognizes physical activity as a major component in the prevention and treatment of heart diseases, and physical inactivity is a major risk factor for heart disease."[7]

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.[8] However, 22% of Canadians smoke, 12% have high blood pressure, and 18% have high blood cholesterol, while 47% of Canadians are physically inactive.[9, 10, 11, 12] In terms of sheer numbers affected, therefore, an increase in physical activity has the greatest potential to reduce the incidence of heart disease in Canada. In Nova Scotia, the comparable prevalence rates for the major modifiable risk factors are: smoking – 23.5%; high blood pressure – 16%; high blood cholesterol – 19%; physical inactivity –50%.[13, 14, 15, 16] Similar data for Health Region 6, which includes Halifax Regional Municipality, are available for smoking (19.3%), high blood pressure (14%), and physical inactivity (48%).[17]

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[7] Heart and Stroke Foundation of Canada 2003. Physical Activity an Effective Heart Disease Prescription. Available at http://ww1.heartandstroke.ca., accessed June 2004.

[8] American Heart Association 1992. "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.

[9] Statistics Canada 2004. Canadian Community Health Survey. Smoking Status by Sex, Household Population aged 12 and over, Canada, Provinces, Territories, Health Regions, and Peer Groups. Available at http://www.statcan.ca/english/freepub/82-221-XIE/00604/tables/html/2118_03.htm, accessed July 2004. *Note that smoking rates here include both daily smokers and occasional smokers for the population aged 12 and older. The rates therefore differ from those in the Tobacco Use Monitoring Survey, which are for the population 15 and older..*

[10] Statistics Canada 2002. Health Indicators, May 2002. High Blood Pressure by Sex, Households Population aged 12 and over. Catalogue No. 82-221-XIE.

[11] Logan, Alexander 1994. *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.

[12] Statistics Canada 2004. Canadian Community Health Survey 2003. Leisure Time Physical Activity, Catalogue no. 82-221, Vol. 2004, No. 1 *Note: these figures differ from the GPIAtlantic Report "The Economic Cost of Physical Inactivity in Nova Scotia" because they are from a different survey. Survey methods are explained in Section II.*

[13] Statistics Canada 2004. Canadian Community Health Survey. Smoking Status by Sex, Household Population aged 12 and over, Canada, Provinces, Territories, Health Regions, and Peer Groups. Available at http://www.statcan.ca/english/freepub/82-221-XIE/00604/tables/html/2118_03.htm, accessed July 2004.

[14] Statistics Canada 2002. Health Indicators, May 2002. High Blood Pressure by Sex, Households Population aged 12 and over. Catalogue No. 82-221-XIE.

[15] Heart Health Nova Scotia and Nova Scotia Department of Health 1995. *The Nova Scotia Health Survey, 1995,* Halifax, page 40 (blood cholesterol levels).

[16] Statistics Canada 2004. Canadian Community Health Survey 2003. Leisure Time Physical Activity, Catalogue no. 82-221, Vol. 2004, No. 1. *Note: these figures differ from the GPIAtlantic Report "The Economic Cost of Physical Inactivity in Nova Scotia" because they are from a different survey. Survey methods are explained in Section II.*

[17] Statistics Canada 2004. Canadian Community Health Survey 2003. Leisure Time Physical Activity, Catalogue no. 82-221, Vol. 2004 and Statistics Canada 2002. Health Indicators, May 2002. High Blood Pressure by Sex, Households Population aged 12 and over. Catalogue No. 82-221-XIE.

A Harvard Medical School meta-analysis estimated that 22% of coronary heart disease in the U.S. could be attributed to physical inactivity.[18] 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.[19]

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.[20]

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.[21] It is estimated that 19% of premature deaths in Canada are attributable to physical inactivity.[22]

Physical inactivity is also linked to obesity, which is itself a risk factor for a wide range of chronic diseases. Obesity has become an epidemic in North America, with childhood obesity having increased by 50% in Canada in the past fifteen years.[23] The most important factors associated with the risk of overweight and obesity are physical inactivity and high-energy dense diets.[24] Lack of physical activity and poor diet are blamed for the increase in childhood obesity, which is of great concern, since an obese pre-schooler has a 25% chance of becoming an obese adult, and an obese teenager has a 75% chance of remaining obese for life.[25] Struber (2004) found that physical inactivity is a greater risk factor for diseases than is obesity.[26] Similar results were found by Crespo et al. (2002) and Katzmarzyk et al. (2003).[27, 28] Struber cites evidence for

[18] 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.
[19] Health Canada 2002. Economic Burden of Illness in Canada, 1998 .Available at http://ebic-femc.hc-sc.gc.ca/ accessed July 2004.
[20] Chen, Jiajian, and Wayne J. Millar 1999. "Health Effects of Physical Activity," Statistics Canada, *Health Reports* 11 (1), Summer, 1999, catalogue no. 82-003-XPB, pages 21-30, especially, page 24.
[21] Colditz 1999, in CFLRI, op. cit.
[22] Canadian Fitness and Lifestyle Research Institute, "The Burden of Inactivity," *The Research File,* reference no. 98-01.
[23] Vail, Susan E. 2001. The Physical Inactivity Epidemic: The Preventative Role of Active School Communities. A Discussion Paper for Delegates of the National Roundtable on Active School Communities, October 18-20, 2001, Charlottetown, PEI. Available at www.centre4activeliving.ca, accessed June 2004.
[24] Mkin, Shirley Bryan and Peter Walsh 2004. Women's Health Surveillance Report- Physical Activity and Obesity. Health Canada. Available at http://www.hc-sc.gc.ca/english/lifestyles/index.html, accessed June 2004.
[25] Vail, Susan E. 2001 op.cit.
[26] Struber, J. 2004. Considering Physical Inactivity in Relation to Obesity. The Internet Journal of Allied Health Science and Practice. Vol. 2, number 1, available at http://ijahsp.nova.edu, accessed June 2004.
[27] Crespo, Carlos J. et al. 2002. Lack of Physical Activity More Life Threatening than Obesity. Review available at www.seniorjournal.com/NEWS/Fitness/2-12-09PhysicalActivity.htm, accessed June 2004.

physical inactivity as a primary and independent factor for all-cause mortality and the development of certain common diseases. She also cites evidence that the prevalence of obesity is more closely related to decreases in energy expenditure than to increases in energy intake.

Another benefit of physical activity is that it 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. 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.[29]

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.[30]

Governmental and health organizations in Canada have recognized that physical activity is a major factor in reducing risks of developing many chronic diseases. In 1997, the Federal, Provincial, and Territorial Ministers responsible for physical activity, recreation, and sport set a goal of increasing physical activity of Canadians by 10% by the year 2003.[31] While that goal has largely been achieved, the Ministers have recognized that the number of inactive people in Canada is still at a very unhealthy level and have set a new goal of another 10% increase in the number of moderately active Canadians by the year 2010.[32] In September, 2002, the Federal, Provincial and Territorial Ministers of Health agreed to work on an Integrated Pan-Canadian Healthy Living Strategy, with the initial areas of emphasis being physical activity, healthy eating, and their relationship to healthy weights.[33] For the 2004 Canadian federal election, the

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[28] Katzmarzyk, P.T., I. Janssen and C.I. Ardem 2003. Physical Inactivity, Excess Adiposity and Premature Mortality. Obesity Reviews. Vol. 4, No. 4, November 2003.

[29] Chen and Millar 1996, 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 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.

[30] Fries, James, C. Everett Koop, Jacque Sokolov, Carson Beadle, and Daniel Wright 1996. "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.

[31] Health Canada 2003. Physical Inactivity Benchmarks Initiatives. Available at www.hc-sc.gc.ca , accessed June 2004.

[32] Canadian Fitness and Lifestyle Research Institute 2004. Increasing Physical Activity: Assessing Trends from 1998-2003. Available at www.cflri.ca, accessed June 2004.

[33] Health Canada 2003. Healthy Living. Available at: www.hc-sc.gc.ca/english/lifestyles/healthyliving/index.html, accessed June 2004.

Canadian Paediatric Society prepared a backgrounder on childhood obesity, which recommended improved municipal planning to encourage walking, active transportation, and outdoor activities; comprehensive community recreation programs, and changes to education policies to increase the amount of physical activity in schools.[34]

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.[35] 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."[36] Recognizing that infrastructure of the United States, such as roads and elevators, encourages people to be inactive, the Centers for Disease Control and the National Parks Service of the U.S. are working together on strategies to increase physical activity among Americans.[37]

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.[38]

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. It is now thought that physical inactivity decreases obesity not just through energy expenditure but through metabolic changes that minimize a decline in resting metabolic rate, preserve lean body mass, reduce blood leptin levels and promote fat oxidation.[39] 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

[34] Canadian Paediatric Society 2004. Federal Election 2004 Issue Backgrounders. Preventing Childhood Obesity. Available at www.cps.ca/english/proadv/Elections/Obesity.htm, accessed June 2004.
[35] Satcher, David M.D., Ph.D, Director, U.S. Centers for Disease Control and Prevention, and Philip R. Lee, M.D., Assistant Secretary for Health, 1996, in Forward to *Physical Activity and Health: A Report of the U.S. Surgeon-General*, op. cit.
[36] Manley, Audrey F,. M.D., 2001. Preface to *Physical Activity and Health: A Report of the U.S. Surgeon-General*, op. cit.
[37] National Park Service, U.S. Department of the Interior. 2001. Fact Sheet. Healthy Communities: Trails and Greenways Promote Physical Activity.
[38] Slattery, Martha, 1996. "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), page 210.
[39] Struber, J. 2004. op. cit.

health through reducing muscle tension (and thereby stress and anxiety) and through biochemical brain alterations and release of endorphins, thereby protecting against depression.[40]

1.2 Physical Inactivity and Urban Planning

Opportunities for people to be physically active occur in four major areas of their day:

- at work,
- during transportation,
- performing domestic duties, and
- leisure time.[41]

In many urban centers, facilities and amenities such as places of work, hospitals and health care, schools, and shopping are not within walking distance for most citizens. This lack of opportunity for walking as part of one's daily routine contributes to physical inactivity. Crowding, crime, traffic, poor air quality, and a lack of parks, sports and recreational facilities, and sidewalks make physical activity a difficult choice for many people.[42] Patterns of land development and investments in particular kinds of transportation can influence health by making choices for physical activity more, or less, convenient. Thus, physical inactivity is a primary means through which urban planning decisions have an impact on public health.

A recent study examined the relationship between obesity, community design, physical activity, and time spent in cars.[43] The study cites evidence that the physical design of places where people live and work affects their overall travel choices and how much they walk or bicycle for utilitarian travel. Researchers tracked the travel patterns of 10,500 residents of Atlanta, Georgia, over a two-year period, recording BMI (body mass index), minutes spent in a car, and kilometres walked, and they controlled for age, income, educational attainment, race and gender. Land use mix showed the strongest association with obesity. The higher the density of neighbourhoods, and the higher the connectedness of routes to various services, the lower the probability of obesity. People who lived in walkable neighbourhoods lowered their risk of obesity by 35 percent. Each additional kilometre walked per day was associated with a 4.8% reduction in the likelihood of obesity. Each additional hour spent in a car per day was associated with a 6% increase in the likelihood of obesity.

Halifax Regional Municipality has embarked on a consultative planning process that will determine the direction of growth and development for years to come. This process provides an excellent opportunity to develop a plan that includes the best options for the economy, the environment, and the health and wellbeing of HRM residents. The goals, objectives and evaluation criteria for the different HRM development scenarios contain many references to

[40] Slattery, 1996. op.cit.
[41] World Health Organization 2003. Global Strategy on Diet, Physical Activity and Health. Available at www.who.int/dietphysicalactivity/publications/facts/pa/en, accessed June 2004.
[42] World Health Organization 2003. Towards Multisectoral Policy in Support of Physical Activity. Available at www.who.int/hpr/physactiv/pa.policy.shtml, accessed June 2004.
[43] Frank, Lawrence D., Martin A. Andresen, and Thomas L. Schmid. 2004. Obesity Relationships with Community Design, Physical Activity, and Time Spent in Cars. American Journal of Preventive Medicine *in press*.

ways to increase physical activity and therefore improve the health of residents.[44] In particular, the following goals have the potential to increase rates of physical activity in HRM:

> *Goal 5.3. Plan lands within communities to accommodate long-term development needs, to be contiguous to existing development, to support active transportation and to be accessible to public transportation.*
>
> *Goal 5.4. Encourage more people to live and work in existing communities where services already exist, while ensuring that new development is compatible with surrounding neighbourhoods.*
>
> *Goal 5.5. Maintain and enhance the quality, character and safety of neighbourhoods through excellence in design, while allowing sufficient scope to adapt to changing needs and markets.*

2. Physical Activity Trends in Halifax Regional Municipality

2.1 Definitions

Surveys of Physical Inactivity

There are a number of definitions of physical activity and inactivity that produce varying results when assessing trends. Because of the wide range of definitions of physical activity and inactivity, the different types of surveys, and the different age groups to which these surveys apply, the following analysis describes different measures of physical activity. Recently the Canadian Fitness and Lifestyle Research Institute (see description below) stopped doing its own surveys, using its own definitions and methodologies, and instead now publishes the physical activity results from Statistics Canada's Canadian Community Health Surveys. This is a welcome change towards greater standardization, as it makes it easier to track physical activity trends using one major survey.

- 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

[44] Halifax Regional Municipality 2004. Regional Planning Goals and Objectives, Jan. 27, 2004.

NPHS and CCHS results apply to Canadians 12 and older.[45] Generally, the "active" category would translate to walking at least one hour every day; the "moderately active" category to walking between 30 minutes and an hour a day; and the "inactive" category to walking less than 30 minutes a day.[46]

- 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.[47]

- 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.[48] Only 34% of Canadians aged 25-55 met these recommendations in 1998.[49]

- 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 (equivalent to 3 kcal per kg of body weight) of physical activity, the minimum judged necessary to obtain health benefits from physical activity.[50] The CFLRI results apply to Canadians 18 and older. The CCHS "physically active" category is the same as the CFLRI category, "sufficiently active for optimal health benefits". However, data from the two surveys are not comparable because they are for different age groups and they use different survey methods. The most recent 2000 CFLRI 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.[51] As of 2002, The CFLRI does not conduct its own survey but reports on the results from the Canadian Community Health Survey.[52]

- 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

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[45] Health Canada 1999. *Statistical Report on the Health of Canadians,* 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.
[46] Canadian Fitness and Lifestyle Research Institute 2004. Increasing Physical Activity: Assessing Trends from 1998-2003. Appendix C.
[47] Statistics Canada, *CANSIM database,* Matrix #M1011.
[48] Health Canada 1998. *Canada's Physical Activity Guide to Healthy Active Living,* Ottawa, 1998.
[49] Canadian Fitness and Lifestyle Research Institute 1998. *Meeting Guidelines. Progress in Prevention Bulletin 31*, Ottawa, 1998, available at: http://www.cflri.ca/cflri/resources/pub_pip.php.
[50] Katzmarzyk, Peter, Normal Gledhill, and Roy Shephard, "The Economic Burden of Physical Inactivity in Canada," *Canadian Medical Association Journal* 163 (11), November 28, 2000, page 1437.
[51] Canadian Fitness and Lifestyle Research Institute, *2000 Physical Activity Monitor,* Available at: http://www.cflri.ca/cflri/pa/surveys/2000survey/2000survey.html., accessed June 2004.
[52] Canadian Lifestyle and Research Institute 2004. Increasing Physical Activity: Assessing Trends from 1998-2003.

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.[53]

For 2003 data we rely on the Canadian Community Health Survey, and for historical data we present results of other surveys. It should be noted that the results of this HRM study are therefore not comparable to those of GPI Atlantic's earlier study on *The Cost of Physical Inactivity in Nova Scotia,* which used the CFLRI definition and data in order to maintain comparability with the results of Katzmarzyk et al (2000), as published in *The Canadian Medical Association Journal (CMAJ).*[54]

The original CFLRI criteria for lack of optimal health benefits were more stringent than those used in the CCHS, so the cost estimates in this study are relatively lower. This is for two reasons: first, the CFLRI categorization of those insufficiently active for optimal health benefits actually comprises two categories in the CCHS -- those who are "inactive" and those who are "moderately active." Therefore the inactive category of the CCHS includes fewer people than the "insufficiently active" category in the CFLRI that was used to determine rates of inactivity in the CMAJ and earlier GPI reports. Secondly, the CFLRI surveyed Canadians 18 years and older, while the CCHS surveyed Canadians 12 years and older, further leading to lower rates of physical inactivity in the CCHS due to the relatively higher activity rates of teenagers.

Health Regions

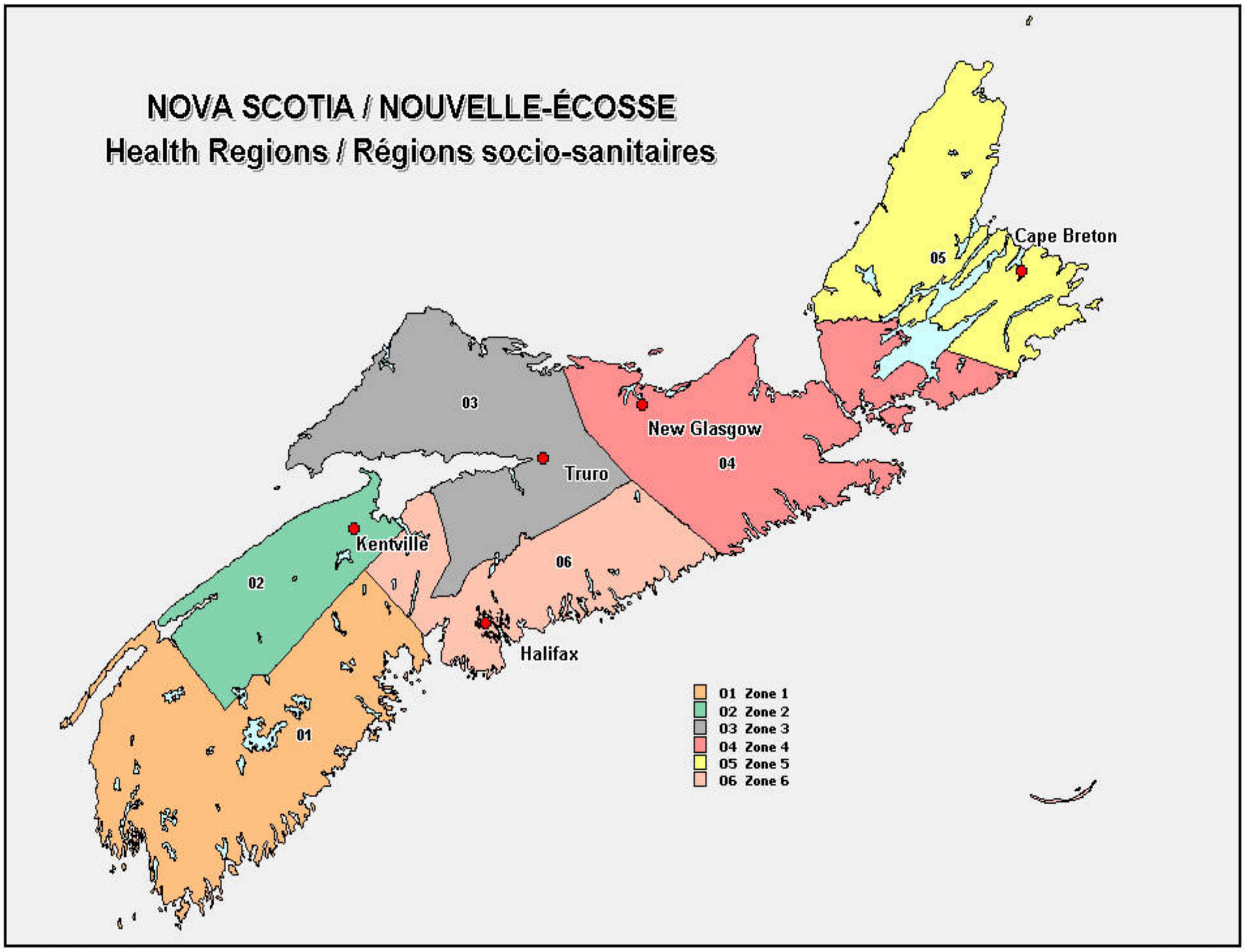
In Statistics Canada's Canadian Community Health Survey, Nova Scotia is broken down into six statistical health zones or regions, as follows:

Zone 1. South-SW: Lunenburg, Queens, Shelburne, Yarmouth, and Digby Counties
Zone 2. Valley: Annapolis and Kings Counties, including Annapolis Royal, Middleton, Kentville, Berwick, and Wolfville.
Zone 3. Cumberland, Colchester, and East Hants Counties.
Zone 4. Pictou-GASHA: Pictou, Antigonish, Guysborough, and Richmond Counties, including New Glasgow, Antigonish, and Port Hawkesbury.
Zone 5. Cape Breton: Cape Breton Island (excluding Port Hawkesbury area). This zone includes the counties of Cape Breton, Victoria and Inverness.
Zone 6. Capital Health District: Halifax Regional Municipality, including eastern shore to Sheet Harbour, and West Hants County, including Windsor.

Some of these statistical health zones do not correspond with the province's administrative health districts. For example, zones 1, 3, and 4 each combine two district health authorities. However, this is not a major problem for this study, as there is considerable correspondence between HRM and Statistics Canada's Zone 6. Zone 6 is almost identical to the Capital Health

[53] Canadian Fitness and Lifestyle Research Institute 1998. *International Consensus Project on Physical Activity Measurement,* Ottawa, available at: http://www.cflri.ca/cflri/research/ipaq.html.
[54] Katzmarzyk, Peter, Normal Gledhill, and Roy Shephard, "The Economic Burden of Physical Inactivity in Canada," *Canadian Medical Association Journal* 163 (11), November 28, 2000.

District of the Nova Scotia District Health Authorities (DHA 9).[55] The Capital Health District (Zone 6), in turn, is only slightly larger than HRM in total population. HRM has a population of 377,900, while the Capital Health District has a population of 388,000.[56,57] Since 97.4% of the population of the Capital Health District is made up of HRM residents, we have used Zone 6 as a proxy for HRM in the following survey results. The following map shows the boundaries of Statistics Canada's six statistical health zones or regions.



Source: Statistics Canada 2004. Available at http://www.statcan.ca/english/freepub/82-221-XIE/01002/images/jpg/ns_ne.jpg.

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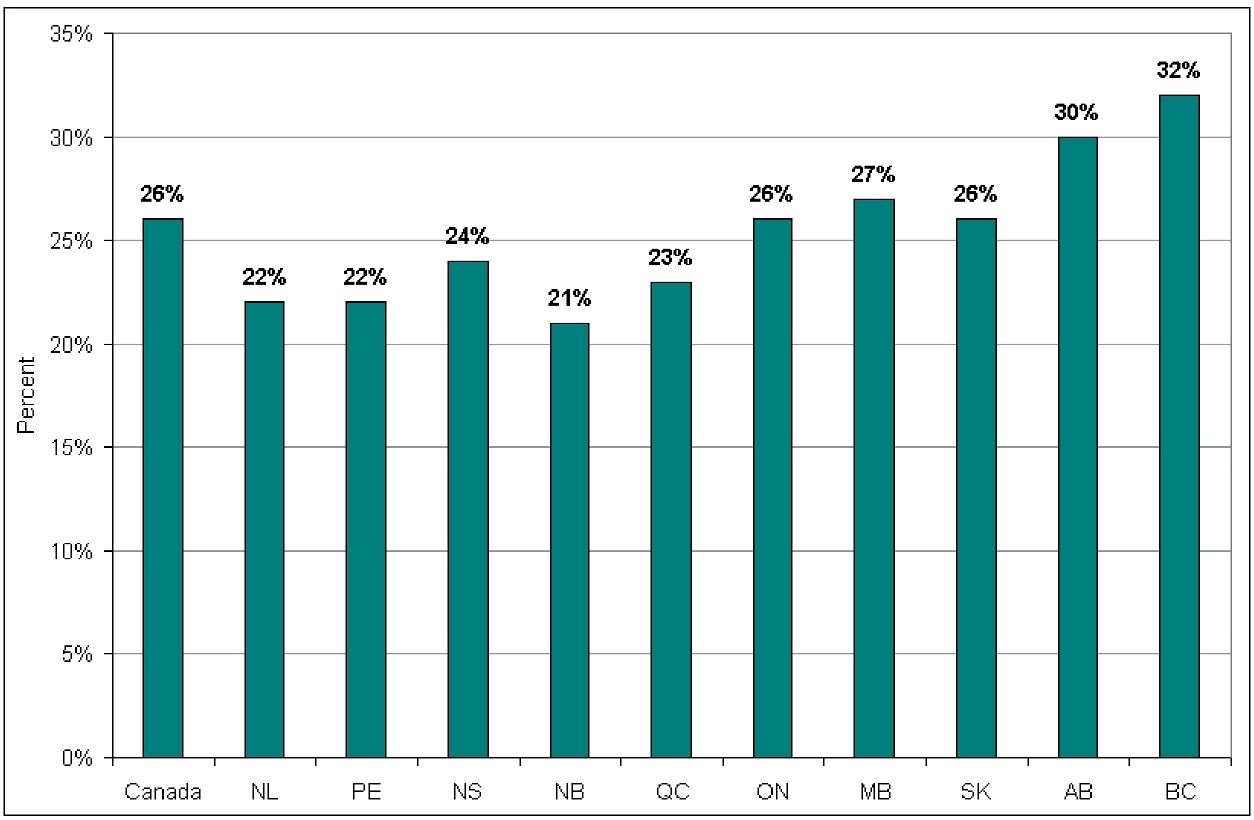
[55] Feeney, Walter, Health Information analyst, Nova Scotia Department of Health, personal communication, July, 2004.
[56] Statistics Canada 2003. Population of Census Metropolitan Areas, 2001 Census Boundaries. Available at www.statcan./ca/english/Pgdb/demo05a.htm, accessed June 2004.
[57] Canadian Institute for Health Information 2004. Health Indicators, Ottawa.

2.2 Canadian Community Health Survey

As mentioned earlier, the Canadian Community Health Survey includes three categories of physical activity: active; moderately active; and inactive. Evidence indicates that the "physically inactive" group is most likely to suffer adverse health consequences, and therefore most of the discussion in this report focuses on physical *inactivity*. In the following discussion the term "physically active" (as in Figure 1 below for example) refers specifically to the CCHS "active" category, and excludes those classified in the CCHS as "moderately active."

According to Statistics Canada's 2003 Canadian Community Health Survey, only 24% of Nova Scotians and 26% of Canadians can be classified as physically active, expending 3.0 or more kilocalories of energy per kilogram of body weight per day (Figure 1). This compares to 32% of British Columbians (the most active in the country). Another 24% of Nova Scotians are moderately active (1.5-2.9 kcal/kg/day), and 50% are inactive (less than 1.5 kcal/kg/day), while the remainder did not state their physical activity.[58] By contrast, 47% of Canadians and 39% of British Columbians are physically inactive. Figure 2 demonstrates an east-west gradient, with eastern Canadians generally more inactive than westerners.

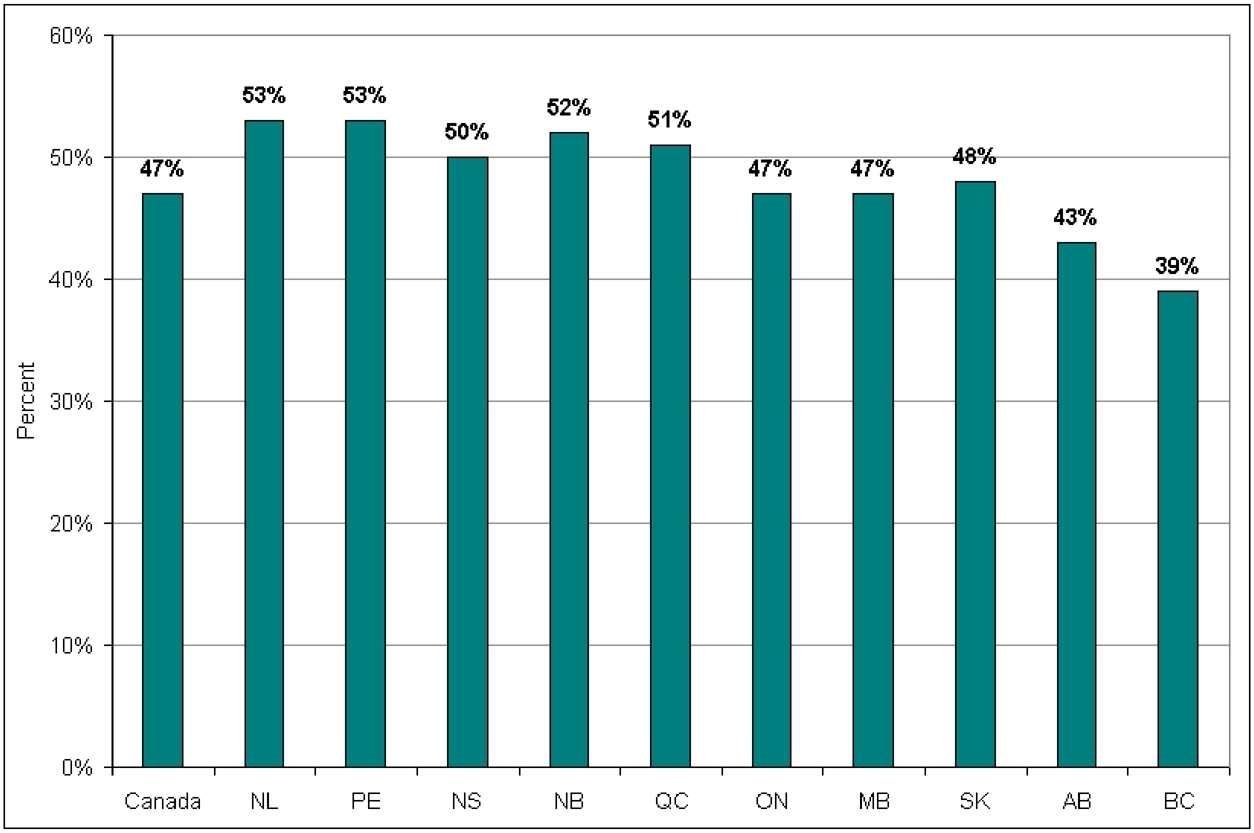
Figure 1. Physically Active Canadians (3.0 kcal/kg/day), Canada and Provinces, age 12+, 2003 (percent)



Source: Statistics Canada, *Canadian Community Health Survey 2003*.

[58] Statistics Canada 2004. Canadian Community Health Survey. Leisure-time Physical Activity by Sex, Household Population aged 12 and over. Catalogue no. 82-221, Vol. 2004, no. 1.

Figure 2. Inactive Canadians (less than 1.5 kcal/kg/day), Canada and Provinces, age 12+, 2003 (percent)



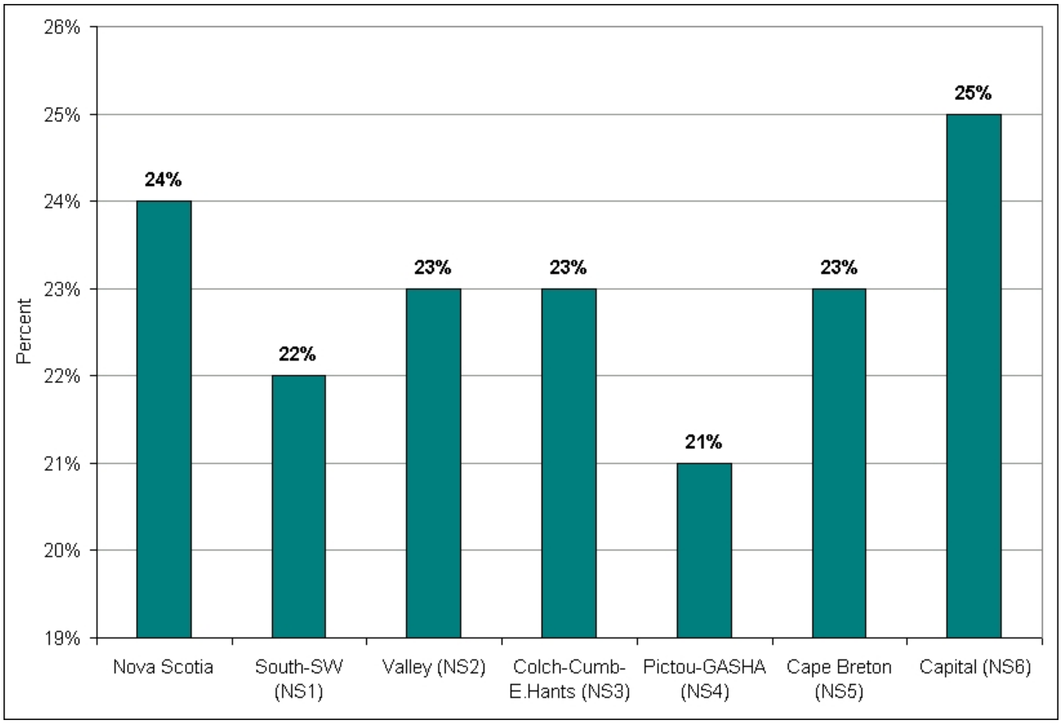
Source: Statistics Canada, *Canadian Community Health Survey 2003*.

The percentages have shown improvement between 2001 and 2003 for the same survey. In 2001, 21% of Canadians were physically active and 49% were inactive, compared with 26% and 47%, respectively, for 2003. Similarly, 21% of Nova Scotians were physically active and 53% inactive in 2001, compared with 24% and 50%, respectively, for 2003. The surveys also reveal differences in levels of physical activity between males and females. In Canada, 44% of men and 50% of women were inactive in 2003. In Nova Scotia, 45% of males and 54% of females are considered physically inactive in 2003.

Looking at the situation within Nova Scotia, the Capital Health District has the highest rate of physical activity (25%), as compared with 24% in Nova Scotia overall (Figure 3). In terms of physical inactivity (Figure 4), Capital Health has the lowest inactivity rate at 48%.

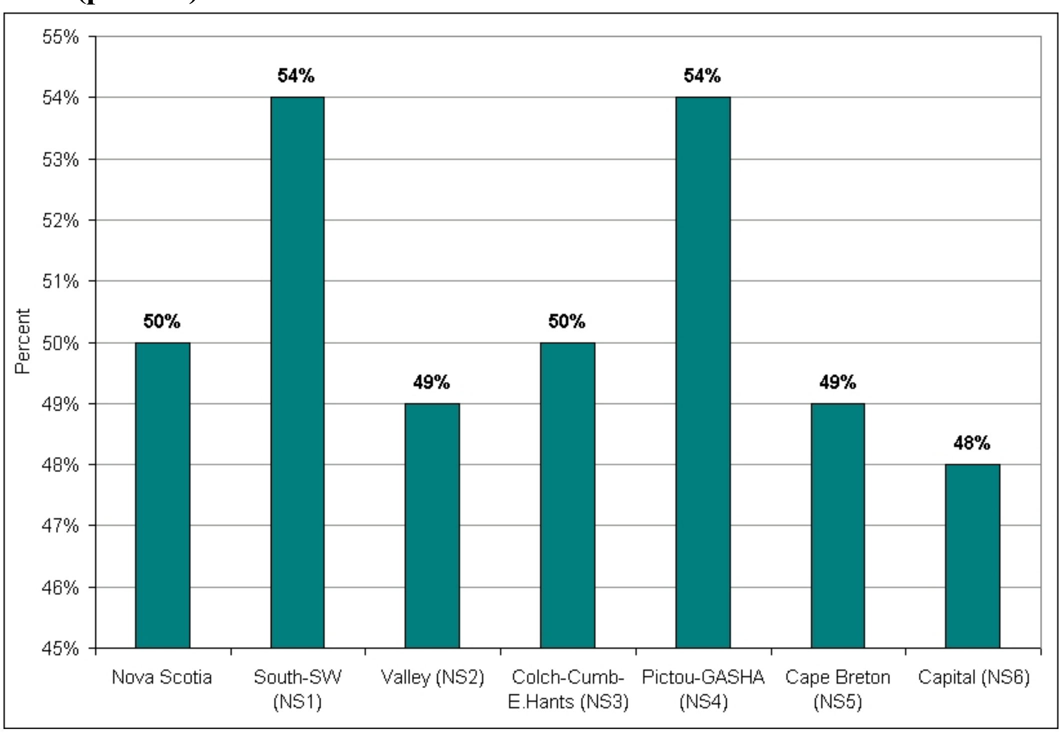
As with the situation across Canada, Nova Scotia data reveal dramatic differences between males and females in terms of physical inactivity (Figure 5). Pictou-GASHA region shows the least difference between males and females, and Cape Breton has the widest gender gap in the province, with 39% of males and 58% of females physically inactive. In the Capital Health District, 43% of males and 52% of females are physically inactive.

Figure 3. Physically Active Nova Scotians (3.0 kcal/kg/day), by Health Region, age 12+, 2003 (percent)



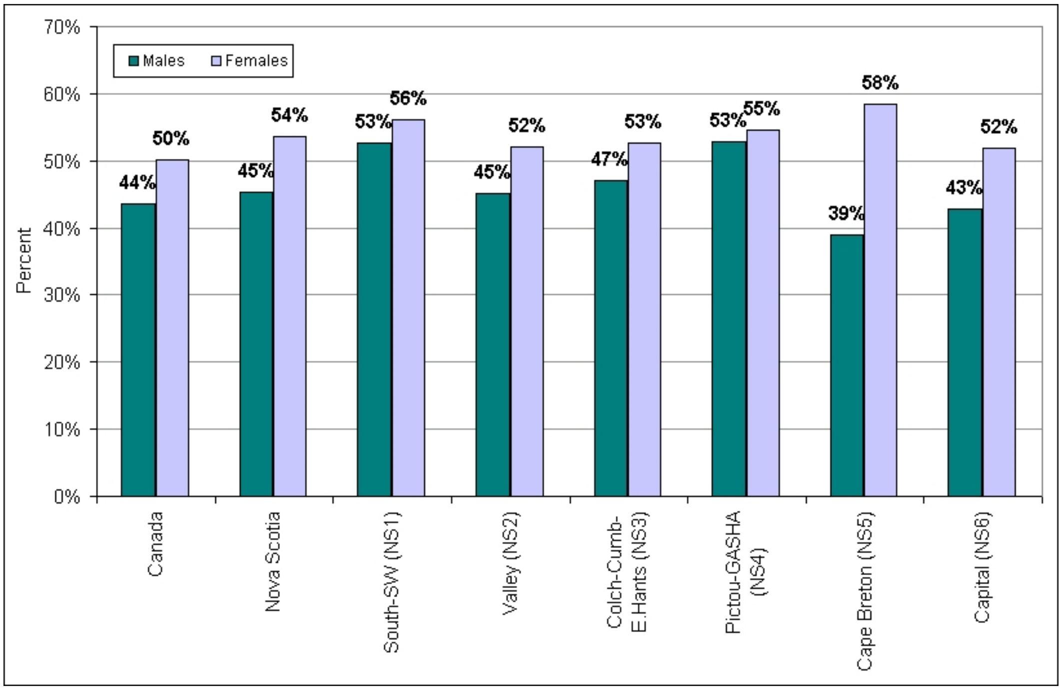
Source: Statistics Canada, Canadian Community Health Survey 2003.

Figure 4. Inactive Nova Scotians (less than 1.5 kcal/kg/day), by Health Region, age 12+, 2003 (percent)



Source: Statistics Canada, *Canadian Community Health Survey 2003*.

Figure 5. Inactive Nova Scotians (less than 1.5 kcal/kg/day), by Health Region and Sex, age 12+, 2003 (percent)

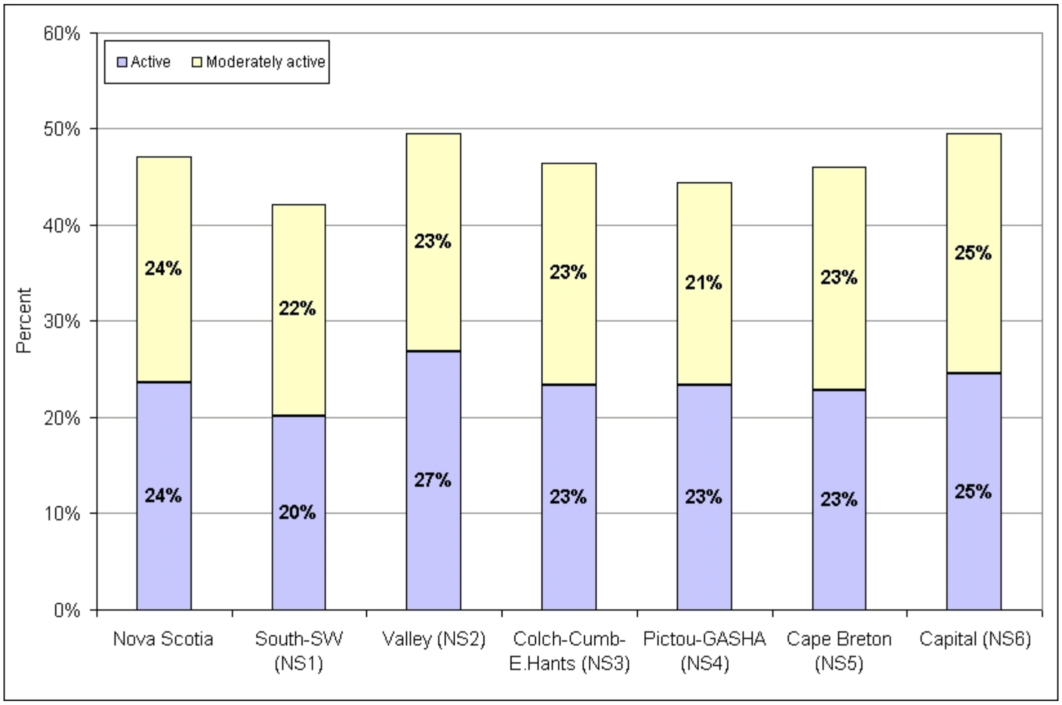


Source: Statistics Canada, Canadian Community Health Survey 2003.

When we look at the total of those both physically active and moderately active (Figure 6), Capital Health has the highest overall rate of physical activity in the Province at 50%, along with the Annapolis Valley. This is higher than the Nova Scotia rate of 47% and considerably higher than South-SW Nova Scotia at 42% and the Pictou-GASHA region at 44%.

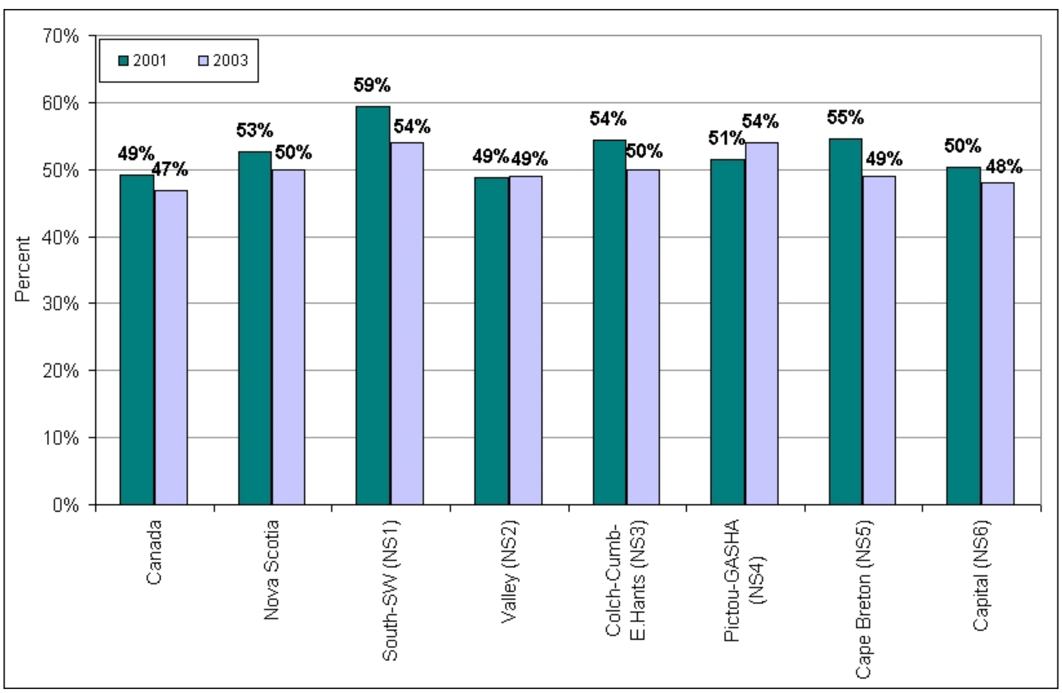
The following discussion focusses on those who are physically *inactive,* and therefore a *decrease* in physical inactivity is seen as an improvement. Between 2001 and 2003, the proportion of those physically inactive in the Capital Health District decreased by 2 percentage points (Figure 7). All other districts showed a decrease in rates of physical inactivity, which constitutes an improvement, except for the Annapolis Valley, which stayed about the same, and Pictou-GASHA, which saw physical inactivity rates increase (worsen) by 3 percentage points. Zones 1, 3, and 5 showed the largest decreases in physical inactivity, ranging from a 4.3 percentage point decrease in Colchester-Cumberland-East Hants to a 5.5 percentage point decrease in Cape Breton – the largest improvement. Nova Scotia as a whole showed a 2.6 percentage point decrease in physical inactivity, compared to a 2.2 percentage point decrease for Canada. Although the Capital Health District has the highest rates of physical activity in the province and has shown improvement over the past two years, 48% of HRM residents still remain inactive.

Figure 6. Active and Moderately Active Nova Scotians (at least1.5 kcal/kg/day), by Health Region, age 12+, 2003 (percent)



Source: Statistics Canada, *Canadian Community Health Survey 2003*.

Figure 7. Change in Physical Inactivity among Nova Scotians, 2001 to 2003, by Health Region (percent)



Source: Statistics Canada, *Canadian Community Health Survey 2001* and *2003*.

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 between 1985 and 1996, 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. As of 1996, all four Atlantic provinces ranked significantly *below* the Canadian average (Figure 3).[59] Although data are available for 2000 for Canada and some provinces, Nova Scotia did not participate in this survey, so results are not presented here.

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 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, over six out of ten Atlantic region men do not exercise regularly in their free time, with declines in male activity rates of 36% in PEI, 18% in New Brunswick, 13% in Nova Scotia, and 4% in Newfoundland between 1985 and 1996. Fifteen years ago, in every Atlantic province, more men than women exercised on a regular basis, by a significant margin. In 1996, in every Atlantic province, more women exercised than men.

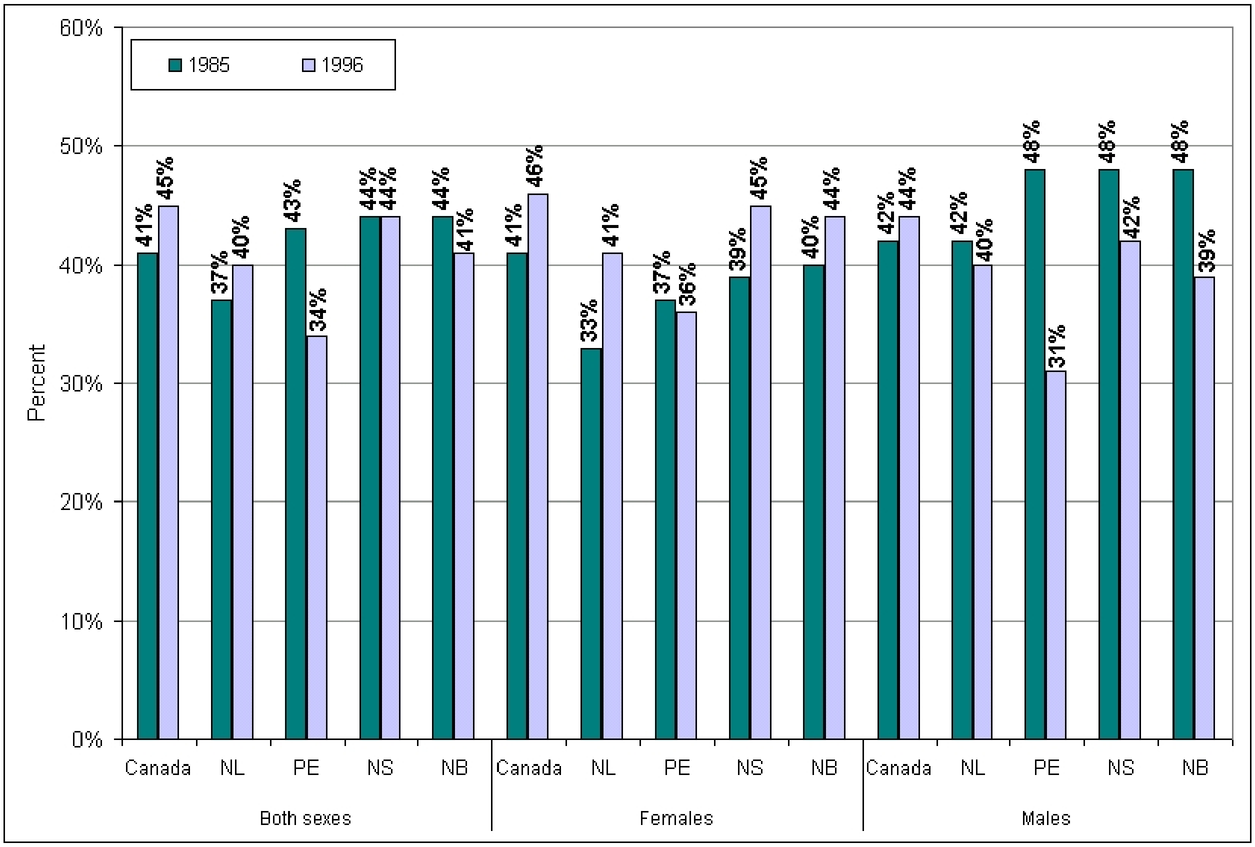
In the long term, the trends indicate that while Atlantic Canadian men had a relatively lower risk of heart disease in 1985 compared to other Canadians, they now have a significantly higher risk, the costs of which will gradually become evident over time.

The Canadian Fitness and Lifestyle Research Institute (CFLRI) Physical Activity Monitor data are not given here, as the CFLRI has now switched from its own definitions and methodologies to using the CCHS data and definitions. However, since the CFLRI has monitored physical activity in Canada since the first Canada Fitness Survey in 1981, the overall long-term trends are noteworthy. They show considerable progress being made over 15 years through the 1980s and early 1990s, with physical inactivity rates gradually falling and physical activity rates rising by an average of one percentage point each year. The CFLRI attributes this positive change to effective education and rising awareness of the health benefits of physical activity. From 1995 to 2000, however, the CFLRI data show that this progress stalled, with little improvement in the late 1990s.

[59] 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.

As noted, the CFLRI no longer conducts its own surveys, but the CCHS data do show a resumption of the earlier positive trends, and a renewed increase in physical activity rates between 2001 and 2003.

Figure 8. Persons Who Exercise, 1985 and 1996 (percent)



Source: Statistics Canada, *CANSIM Database*.

2.4 Means of Commuting

The preceding discussion has focused on physical inactivity during leisure time, since these are the most readily available statistics and the only ones that provide data at the level of health regions. However, it is important to consider the physical activity that occurs through use of active modes of commuting.

According to the CFLRI 2001 Physical Activity Monitor, 51% of Canadian adults (18 and over) walked either to work, school, or for errands on an average of 153 days per year, for an average of 40 minutes a day.[60] Thirteen percent bicycled to commute on an average of 57 days a year for an average of 36 minutes per day. In Nova Scotia, 40% walked to work, school, or for errands on an average of 146 days a year and for an average of 42 minutes a day. Percentages for bicycling

[60] Canadian Fitness and Lifestyle Research Institute 2004. Increasing Physical Activity: Assessing Trends from 1998-2003. Ottawa. Available at www.cflri.ca, accessed June 2004.

to commute in Nova Scotia were not available for 2001, but the 2000 CFLRI Physical Activity Monitor reported that 10% of Nova Scotians bicycled to commute for an average of 64 days per year.[61] These data are based on a telephone survey with a sample of 387 adults in Nova Scotia and include commuting for all purposes, not just for work.

According to Statistics Canada Census data, only 8.3% of the Nova Scotian employed labour force walked to work and just 0.6% bicycled to work in 2001.[62] According to the Census data, 10.3% of the people commuting to work in Halifax walked to work. Data were not provided for the percentage who bicycle in HRM.

According to the CFLRI, 29% of Canadian children chose an active means (walking or cycling) of commuting to school in 2000, while 24% of Nova Scotian children actively commuted to school.[63]

In addition to health benefits, active commuting and reduced automobile use improve environmental quality by reducing air pollution and greenhouse gas emissions, and decreasing the "ecological footprint". The ecological footprint measures the human impact on the environment by assessing how much land area is required to provide the resources we use and to absorb the waste we produce. Commuting by car contributes 12 times more than cycling to the ecological footprint. The commuting footprint (the land required for the resource use and waste absorption related to commuting) can be reduced by 92% when a person cycles or walks to work rather than driving. Even cycling or walking three days a week produces a 55% reduction in the commuting footprint.[64]

There is a great deal of opportunity for residents of HRM to increase physical activity through active commuting, as well as through increased exercise during leisure time. Active commuting can be supported by convenient and safe sidewalks and bicycle paths, as well as by having walkable communities with places of work, school, and shopping within walking distance of home. Access to reliable public transportation that is within walking distance of homes can also partially increase active commuting.

2.5 Barriers to Physical Activity

According to the CFLRI 2002 Physical Activity Monitor, lack of time (75%), energy (64%), and motivation (62%) are the most frequently noted barriers to physical activity among Canadians.[65] For Nova Scotians, the percentages are similar: 76% cite lack of time; 68%, lack of energy; and 57%, lack of motivation as their primary reasons for not being more physically active.

[61] Canadian Fitness and Lifestyle Research Institute 2001. Increasing Physical Activity: Supporting Children's Participation. Available at www.cflri.ca, accessed June, 2004.
[62] Statistics Canada 2003. Employed Labour Force by Mode of Transportation to Work, Provinces and Territories, 2001 Census. Available at www.statcan.ca/english/Pgdb/labor42a.htm, accessed June 2004.
[63] Canadian Fitness and Lifestyle Research Institute 2001.op.cit.
[64] Wilson, Jeff, Ronald Colman, and Anne Monette 2001. *The Nova Scotia Ecological Footprint*. Available at www.gpiatlantic.org , accessed July 2004.
[65] Canadian Fitness and Lifestyle Research Institute 2004. op.cit.

Forty-nine percent of Canadians and 52% of Nova Scotians noted that access to safe streets and public places was an important consideration in increasing physical activity. Access to paths, trails, and open spaces was rated important by 42% of Canadians and 40% of Nova Scotians.[66]

While it may be difficult for society to address lack of time and energy directly, public education can provide support for developing motivation, and in informing the public of the health benefits of physical activity. Clearly, safe and adequate sidewalks, streets, and trails are an important component in increasing physical activity that can be addressed by the HRM planning process. One of the most important considerations for urban planning, which can increase rates of physical activity, is the provision of services within walking distance for most residents.

3. The Economic Cost of Physical Inactivity

3.1 Methodology

Several studies have now been published on the economic cost of physical inactivity in Canada. The first, a study in 2000 at the national level by Katzmarzyk et al., published in the *Canadian Medical Association Journal (CMAJ)* provided methodology that allowed further studies.[67] A second study by GPI Atlantic examined the same costs for Nova Scotia, using the methodology and relative risk ratios from the CMAJ study.[68] In February 2003, Katzmarzyk and Janssen published a similar study for Ontario.[69] This study of the costs of physical inactivity in Halifax Regional Municipality follows the methodology provided by Katzmarzyk et al.(2000) and Colman (2002), as updated by Katzmarzyk and Janssen (2003). In particular, the latter study used the CCHS data and definitions of physical inactivity, while the first two used the CFLRI data and definitions. For convenience, these studies will be referred to in the text as Katzmarzyk CA, GPINS, and Katzmarzyk ON, respectively. While changes in methodology, definitions, and data sources, and updated statistics mean that the numbers are not always exactly comparable, these studies do allow basic assessments and comparisons of the costs of physical inactivity in various provinces and Canada.

To estimate the economic costs of physical inactivity (or of any other risk factor) in Halifax Regional Municipality, 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

[66] Canadian Fitness and Lifestyle Research Institute 2004. op.cit.
[67] Katzmarzyk et al. 2000, op. cit.
[68] Colman, Ronald, GPI Atlantic 2002. *The Cost of Physical Inactivity in Nova Scotia*, prepared for Recreation Nova Scotia and Sport Nova Scotia. Available at www.gpiatlantic.org., accessed July 2004.
[69] Katzmarzyk, Peter and Ian Janssen 2003. The Economic Costs Associated with Physical Inactivity and Obesity in Ontario, 2001. Leisure Information Network, Ontario Department of Health.

particular disease for a physically inactive person compared to an active person.[70] 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 as those who are physically active, 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 in Katzmarzyk CA, as updated in Katzmarzyk ON. GPI Atlantic used the same method in early 2000, to assess the cost of obesity in Nova Scotia.[71] To the best of our knowledge the Katzmarzyk CA article, published in CMAJ, 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.

2) The second step is to ascertain the prevalence of a risk factor within a given population. Although Katzmarzyk CA and GPI NS used the Canadian Fitness and Lifestyle Research Institute's Physical Activity Monitoring Survey results, Katzmarzyk ON used the 2000/2001 Canadian Community Health Survey. Since CFLRI now uses the CCHS data, the current study uses the most recently available data from the 2003 CCHS, released in June 2004.[72] The rates of physical inactivity in the CCHS 2003 are lower than those in the CFLRI surveys, partly because the population surveyed in the CCHS is aged 12 and over, whereas the CFLRI surveys people 18 and older, and partly because the CFLRI standards were higher. The CCHS provides rates of physical inactivity for the six Health Zones in Nova Scotia. As mentioned in Part 1, the current study uses the Capital Health District (Zone 6) as a proxy for Halifax Regional Municipality, since 97.4% of the population of the Capital Health District is made up of HRM residents.

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 (PAF) of a disease is, therefore, the proportion of each chronic disease that could theoretically be prevented by eliminating physical inactivity.[73]

The population attributable fraction (PAF) for each disease is calculated as

$$[P(RR - 1)] / [1 + P(RR - 1)]$$

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[70] 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.

[71] 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.

[72] Statistics Canada 2004. Canadian Community Health Survey. Leisure-time Physical Activity by Sex, Household Population aged 12 and over.

[73] Methodological explanation from CFLRI, "The Burden of Inactivity" and "The Economic Case for Physical Activity," op. cit.; and Katzmarzyk et al 2000, op. cit., page 1437.

where P is the prevalence of physical inactivity in the population (in this case 48%), and RR is the relative risk for the disease in an inactive person. The results from steps 1-3 are presented in Table 1.

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 1998), which describes illness costs by diagnostic category.[74] In other words, we estimate the direct health care costs of treating the particular diseases that are linked to physical inactivity by using the PAR of each disease to estimate the portion of those costs that are attributable to physical inactivity.

   Because EBIC 1998 provides illness costs by diagnostic category only at the provincial and national levels, and not at the municipal level, three distinct steps are actually involved *within* Step 4 in order to estimate illness costs attributable to physical inactivity in HRM: First, total illness costs by diagnostic category attributable to the health problems of HRM residents are estimated by dividing the provincial cost estimates by the HRM population. Then these costs are adjusted to reflect the actual incidence of the disease in HRM by comparison with the provincial rates. In almost all cases, HRM residents have lower rates of chronic illness than the rest of the province. Then these disease costs for HRM are multiplied by the PAF for HRM as determined by steps 1-3 above.

   It must be acknowledged that there is likely to be a small amount of double-counting in the three-part process that is used here for assessing the illness costs attributable to physical inactivity in HRM. This is because the lower incidence rates for particular illnesses in HRM *already* reflects HRM's lower PAF for physical activity. However, the lower disease incidence rates in HRM *also* reflect lower PAFs for other risk factors like smoking and obesity, where HRM rates are also lower than provincial averages. Because there is no way to separate these factors out in this analysis to determine the proportion of lower costs attributable to each separate risk factor, we have proportionately lowered the overall disease cost estimates for HRM to reflect the lower incidence of most of these illnesses in HRM, and then multiplied by the PAF for physical inactivity. This makes the resulting cost estimates for illness attributable to physical inactivity in HRM somewhat more conservative than would be the case if the separate risk factors were first considered before deriving the HRM illness cost estimates.

   The first part of this 3-part analysis for Step 4 (estimating illness costs by diagnostic category for HRM) is based on the basic methodology of Katzmarzyk CA and ON in assigning costs to particular diseases, but the costs are updated and adjusted for data specific to Nova Scotia whenever possible. Katzmarzyk ON determined Ontario costs from EBIC 1998 by multiplying the Canadian costs by the overall proportion of the Canadian direct and indirect costs incurred in Ontario. We have followed this method to determine these costs first for Nova Scotia. Then, to determine illness costs by diagnostic category for Halifax Regional

[74] Health Canada 1993. The Economic Burden of Illness in Canada, Available at: http://hc-sc.gc.ca/pphb-dgspsp/publicat/ebic-femc93 *and* Health Canada 2002. The Economic Burden of Illness in Canada 1998 (and on-line data) available at: http://www.ebic-femc.hc-sc.gc.ca.

Municipality, the Nova Scotia costs are multiplied by 40.37%, which is the percentage of the Nova Scotia population contained in HRM.[75]

For part two of the 3-part analysis, Statistics Canada data on disease incidence by health region are used to adjust the population-based estimates in part one of the analysis (paragraph above). For example, if the incidence rate of a disease in HRM is 8 people per 100,000 and the incidence of the same disease in Nova Scotia is 10 people per 100,000, then we multiply the HRM costs by 8/10 or 80%. Incidence rates for diabetes and high blood pressure by health region are available from the 2003 CCHS.[76, 77] For high blood pressure, the incidence in Capital Health District in 2003 was 50,815 and in Nova Scotia, 144,531; therefore we multiplied by 35%. For diabetes, the incidence in HRM was 14,246 and in Nova Scotia 43,720; therefore we multiplied the costs by 32.6%. Age-standardized colorectal and breast cancer incidence rates by health region are available for 1997-98 (the most recently available date) from Statistics Canada's Health Indicators.[78, 79] Colorectal cancer rates are used here as a proxy for colon cancer incidence. In 1997-98, the incidence of breast cancer was 111.3 per 100,000 in Capital Health District and 105.3 in Nova Scotia; therefore we multiplied the costs by 1.06. The incidence of colorectal cancer in Capital Health District was 58.1 per 100,000 and in Nova Scotia, 59 per 100,000; therefore we multiplied the costs by 98.5%.

Coronary heart disease and stroke incidence rates are not available separately by health region. However, ischaemic heart disease death rates and cerebrovascular disease death rates for 1997 (the most recent available date) are available for the health regions including the Capital Health District. In each case, those rates are lower in HRM than in the province as a whole.[80, 81] Therefore, these 1997 comparative death rates are used as a proxy to adjust downwards the illness costs attributable to coronary heart disease and stroke in HRM, on the

[75] Statistics Canada 2003. Population of Census Metropolitan Areas, 2001 Census Boundaries. Population of Nova Scotia is 936,000 and of HRM 377,900.
[76] Statistics Canada 2004. Canadian Community Health Survey. Diabetes by Sex, Household Population aged 12 and over, Canada, Provinces, Territories, Health Regions and Peer Groups, 2003 Catalogue 82-221-XIE. Available at: http://www.statcan.ca/english/freepub/82-221-XIE/00604/tables/html/1248_03.htm, accessed July 2004.
[77] Statistics Canada 2004. Canadian Community Health Survey. High Blood Pressure by Sex, Household Population aged 12 and over, Canada, Provinces, Territories, Health Regions and Peer Groups, 2003. Available at http://www.statcan.ca/english/freepub/82-221-XIE/00604/hlthstatus/conditions4.htm , accessed July 2004.
[78] Statistics Canada 2003. Canadian Community Health Survey . Colorectal Cancer Incidence (ICD-9 153-154) Age-standardized Rate per 100,000 Population and Confidence Interval, Canada, Provinces, Territories and Health Regions, 1997-98. Available at http://www.statcan.ca/english/freepub/82-221-XIE/00604/hlthstatus/conditions4.htm , accessed July 2004.
[79] Statistics Canada 2003. Canadian Community Health Survey . Female Breast Cancer Incidence (ICD-9 174) Age-standardized Rate per 100,000 Population and Confidence Interval, Canada, Provinces, Territories and Health Regions, 1997-98. Available at http://www.statcan.ca/english/freepub/82-221-XIE/00604/hlthstatus/conditions4.htm , accessed July 2004
[80] Statistics Canada 2002 Canadian Community Health Survey. Ischaemic Heart Disease Deaths (ICD-9 410-414), Age-standardized Rate per 100,000 Population and Confidence Interval, by Sex, Canada, Provinces, Territories, Health Regions and Peer Groups, Available at http://www.statcan.ca/english/freepub/82-221-XIE/01103/hlthstatus/deaths3.htm , accessed July 2004.
[81] Statistics Canada 2002 Canadian Community Health Survey. Cerebrovascular Disease Deaths (ICD-9430-438), Age-standardized Rate per 100,000 Population and Confidence Interval, by Sex, Canada, Provinces, Territories, Health Regions and Peer Groups, Available at http://www.statcan.ca/english/freepub/82-221-XIE/01103/hlthstatus/deaths3.htm , accessed July 2004

assumption that the incidence of these diseases is also lower in HRM than in the rest of the province and on the assumption that the costs are therefore proportionately lower. In 1997, deaths due to heart disease in Capital Health District were 125.2 per 100,000 and in Nova Scotia, 134.5; therefore we multiplied by 93.1%. For stroke, the incidence in Capital Health in 1997 was 41.7 per 100,000 and in Nova Scotia, 44.8 per 100,000. Therefore we multiplied the costs by 93%.

Osteoporosis rates are not available by health region. So the derived provincial cost estimates for this illness are simply adjusted downwards according to population. For osteoporosis, therefore, no additional adjustments for disease incidence are made, and the estimated Nova Scotia costs are simply multiplied by 40.37%, which is the percentage of the Nova Scotia population contained in HRM. Further details of calculations of costs for specific diseases from the EBIC data are provided in Section 3.2 (direct costs) and 3.3 (indirect costs).

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.[82] 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 HRM. Although it is not possible at this stage to derive an accurate PAF for mental illness in relation to physical inactivity, it is considered more accurate to attempt a cost estimate for this category than to assign it an arbitrary value of zero.

Other cost estimates omitted by Katzmarzyk CA and Katzmarzyk ON relate to association of physical activity with dyslipidemia (cholesterol imbalance), 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, pulmonary embolism, arthritis, sleep disorders, and a range of other medical problems in addition to the diagnostic categories described here, physical inactivity may indirectly contribute to ailments that are not included in the costs estimates in Table 2. For costs of obesity in Nova Scotia, the reader is referred to the GPI Atlantic study.[83]

5) The number of premature deaths attributable to physical inactivity in HRM is estimated by multiplying the deaths attributable to each inactivity-related disease by the PAF for that disease. The number of deaths in HRM due to each disease is estimated as the total deaths for DHA Region 9, which is almost identical to Statistics Canada's statistical Zone 6.[84]

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[82] Aldana, Steven 2001. "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.
[83] Colman, Ronald 2000. Cost of Obesity in Nova Scotia. Available at www.gpiatlantic.org , accessed July 2004.
[84] Feeney, Walter, Health Information Analyst, Nova Scotia Department of Health, Personal Communication, July 14, 2004. *Type 2 diabetes deaths are estimated at 92.5% of total diabetes deaths.*

Calculations of potential years of life lost and deaths were supplied by the Nova Scotia Department of Health.[85]

6) Finally, the savings that could potentially be realized from a 10% reduction in physical inactivity are derived from the above estimates. Katzmarzyk CA estimated the savings that could be realized by a 10% reduction in physical inactivity among Canadians by recalculating the PAF of each disease and the corresponding costs using a reduced prevalence of inactivity. As the current HRM inactivity rate is 48%, a 10% reduction in activity would lead to an inactivity rate of 43.2%. Therefore the PAFs for HRM are recalculated based on an inactivity rate of 43.2%, and the costs are adjusted accordingly.

3.2 Direct Costs of Physical Inactivity, HRM

Risk Factors and Population Attributable Fractions for Diseases

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 HRM's physical inactivity prevalence rate of 48%. This table corresponds with Table 2 in Katzmarzyk CA.[86]

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. 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)[87] of 29.9% for heart disease means that nearly one-third of heart disease in HRM could be avoided if all residents were physically active. Table 1 also indicates that 16% of stroke, hypertension, colon cancer, and type 2 diabetes, as well as 22% of osteoporosis and 8.7% of breast cancer, could be eliminated if HRM residents who are presently sedentary became physically active.

The most likely explanation for the differences in 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 Section 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 PAFs for each disease.

The population attributable fractions for each disease for HRM calculated here are lower than those reported in the GPI report on Physical Inactivity in Nova Scotia because that report

[85] Feeney, Walter 2004, op.cit..
[86] Katzmarzyk et al, 2000, op cit.
[87] The terms PAF (population attributable fraction) and PAR (population attributable risk) are used interchangeably in this study.

(following Karzmarzyk CA) used the CFLRI physical inactivity prevalence rates (62% for Nova Scotia), whereas the current report uses the CCHS inactivity rates (49.7% for Nova Scotia and 48% for HRM), for the reasons explained earlier.[88]

Table 1. Physical Inactivity Prevalence (P), Relative Risk (RR) and Population Attributable Fraction (PAF) due to Physical Inactivity for Major Chronic Diseases, Halifax Regional Municipality, 2003

Disease	P	RR (95% CI)	RR-1	PAF (%)
Coronary heart disease	0.48	1.9 (1.6-2.2)	0.9	29.9
Stroke	0.48	1.4 (1.2-1.5)	0.4	16.0
Hypertension	0.48	1.4 (1.2-1.6)	0.4	16.0
Colon cancer	0.48	1.4 (1.3-1.5)	0.4	16.0
Breast cancer	0.48	1.2 (1.0-1.5)	0.2	8.7
Type 2 diabetes	0.48	1.4 (1.2-1.6)	0.4	16.0
Osteoporosis	0.48	1.6 (1.2-2.2)	0.6	22.2

Note: Based on a prevalence of physical inactivity of 48% in Nova Scotia in 2003 according to the Canadian Community Health Survey.

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 HRM cost estimates in Table 2 below. It is important to note that while we have used physical inactivity rates from 2003, the cost figures are from the *Economic Burden of Illness in Canada, 199*8 (EBIC 98), which was published in 2002 but used 1998 cost figures. These are the latest cost figures available. While we have converted the costs to 2003 Canadian dollars using the Consumer Price Index, it is unlikely that this conversion fully accounts for the steady and sharp increase in health care expenses between 1998 and 2003, and therefore the estimates of costs are likely low.

Direct Cost Calculations

EBIC 98 provides total Canadian costs for direct and indirect health expenditures by category of spending. Direct categories include costs for hospitals, drugs, physicians, other institutions, and additional direct expenditures. Other institutions include residential care facilities for the chronically ill and disabled who reside there more or less permanently. The *additional direct costs* category includes other health professionals, public health and health research, and capital expenditures. Katzmarzyk CA provided a separate category for research, but did not include

[88] Colman, Ronald 2002. The Cost of Physical Inactivity in Nova Scotia. GPI Atlantic. Available at www.gpiatlantic.org

costs for other institutions or additional direct costs. GPI NS included other institutions and additional direct costs in a category called "other" but also broke out costs for research. In this regard, we have followed the GPI NS study here.

EBIC 98 provides the health expenditures in each of the above cost categories broken down by 18 diagnostic categories. The categories of concern for physical inactivity are cardiovascular diseases; cancers, endocrine and related diseases (including diabetes), and musculoskeletal diseases (including osteoporosis). Provincial totals are available from EBIC online for these categories, but the costs for specific disease categories within these broad classifications had to be derived through use of incidence rates, at the provincial level where possible, but if not then at the national level.

For example, the total cancer costs for Nova Scotia are multiplied by the percentage of cancer cases in Nova Scotia that are breast cancer to produce an approximate estimate for total Nova Scotia costs attributable to breast cancer. Clearly different types of cancer carry different medical costs and produce different types of disabilities. But cost estimates are not available by type of cancer, so this use of incidence rates is necessary here to yield approximate estimates for the two types of cancer most closely associated with physical inactivity – colon cancer and breast cancer. The specific methods used to estimate costs attributable to sub-categories of cardiovascular disease (coronary heart disease, stroke, and hypertension) and to type 2 diabetes are described below.

In EBIC 98, for the *other* category (*other institutions* and *additional direct costs),* the costs are not broken into disease category at the provincial level. To estimate these costs by disease category for Nova Scotia, therefore, we calculated the national ratio of *other* costs to the sum of costs for *remaining direct costs* (hospital, doctor, drug, and research). For Nova Scotia, *other* costs amount to 46% of remaining direct costs (hospital, doctor, drug, research). For each disease category, we then multiplied the sum of *remaining direct* costs by this percentage to estimate the costs for that disease in the *other* category. This method assumes that the overall Nova Scotia ratio of other costs to remaining direct costs is the same for each diagnostic category. While this derived method is certainly not ideal, it is considered preferable to the option of omitting other direct costs entirely, which would significantly underestimate actual costs. As mentioned previously, HRM costs were estimated by using 40.37% of Nova Scotia costs, and then adjusted for the difference between HRM and Nova Scotia incidence rates for each disease category.

Cardiovascular diseases

The cardiovascular diseases associated with physical inactivity are coronary heart disease, stroke, and hypertension. The 1998 EBIC does not provide Nova Scotia data for these illnesses separate from the broader category of cardiovascular diseases. Katzmarzyk CA used costs specific to coronary heart disease and stroke from the 1993 EBIC. Katzmarzyk ON, using 1998 EBIC costs, estimated the costs of coronary artery disease and stroke by multiplying total cardiovascular disease costs in 1998 by the percentage of total cardiovascular disease costs that were specifically attributable to coronary artery disease (28.2% direct; 42.8% indirect) and stroke (19.6% direct; 9.9% indirect) reported in EBIC 93. To estimate costs of hypertension, Katzmaryzk ON used the proportion of direct (17.8%) and indirect (9.2%) costs of cardiovascular disease attributed to hypertension in the United States.

For Nova Scotia direct costs attributable to coronary heart disease, stroke, and hypertension, the current study uses the most specific data available: We use the EBIC 98 national percentages of cardiovascular disease costs for physicians, hospitals, drugs, and research that are specifically attributable to coronary artery disease: 30.6% of hospital costs; 30.3% of physician costs; 28.9 % of drug costs; and 2.26% of the research costs attributable to cardiovascular diseases are specifically attributable to coronary heart disease in EBIC 98. For stroke, the EBIC 98 proportion of cardiovascular diseases was used for hospital costs (17.2%) and the EBIC 93 proportion was used for drug, physician, and research costs (8.6%; 7.1%; and 0.8%, respectively), since the latter three breakdowns were not available in EBIC 98.

The proportion of cardiovascular costs due to hypertension at the provincial level is derived from national ratios of hypertension costs to total cardiovascular costs. For hypertension cost estimates, we used the percentages from Katzmaryzk CA for hospital and physician costs (5.7% and 28.7%, respectively); from EBIC 98 for drug costs (49.6%) and from GPINS for research costs (80%), which in turn were based on derivations from the EBIC numbers. These provincial derivations from national ratios are considered reasonable, as it is unlikely that the proportion of specific disease costs to total cardiovascular disease costs differs markedly by province.

Colon cancer and breast cancer

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 2004.*[89] Colorectal cancers account for 14.5% of all cancers in Nova Scotia. According to Katzmarzyk CA, colon cancers constitute 67.1% of total colorectal cancers, so that colon cancers would amount to about 9.7% of all cancer incidence in Nova Scotia. This is close to the 8.6% estimate used by Katzmarzyk CA, with the difference likely explained by the fact that Nova Scotia has considerably higher colorectal cancer rates than the Canadian average (59% compared to 49.9%). In fact, Nova Scotia has the second highest rate of colorectal cancer in the country after PEI.[90] Breast cancer accounts for 11.1% of all cancers in Nova Scotia.[91]

Type 2 Diabetes

The EBIC diabetes estimates are adjusted to account for the fact that type 2 diabetes cases constitute 92.5% of diabetes cases. The Nova Scotia specific cost estimates from the 1998 EBIC include diabetes in the endocrine and related disorders diagnostic category. In the 1998 EBIC,

[89] National Cancer Institute of Canada 2004. Canadian Cancer Statistics 2004.. Available at http://www.cancer.ca , accessed June 2004.
[90] Statistics Canada 2003. Canadian Community Health Survey . Colorectal Cancer Incidence (ICD-9 153-154) Age-standardized rate per 100,000 Population and Confidence Interval, Canada, Provinces, Territories and Health Regions, 1997-98. Available at http://www.statcan.ca/english/freepub/82-221-XIE/00604/hlthstatus/conditions4.htm , accessed July 2004.
[91] National Cancer Institute 2004,.op.cit.

diabetes in Canada constituted 42.7% of all hospital costs and 22% of all drug costs for endocrine and related disorder health care costs. In EBIC 93, 47.3% of all physician costs and 35% of research costs for all endocrine diseases were due to diabetes. These percentages were used to calculate Nova Scotia costs for diabetes, and 92.5% of these costs were then considered attributable to type 2 diabetes.

Osteoporosis

Osteoporosis costs are not separated out in the EBIC from the general musculoskeletal disease diagnostic category. Katzmarzyk ON therefore used an independent assessment of the burden of illness due to osteoporosis in Canada, pegged at $744.4 million in 1993. He then divided this estimate by the total cost of musculoskeletal diseases in 1993 (from EBIC 1993) to arrive at a percentage of musculoskeletal costs that could reasonably be attributable to osteoporosis (30.3%). Here we apply this percentage to Nova Scotia total musculoskeletal costs to arrive at an estimate of Nova Scotia costs for osteoporosis. It should be noted that this estimate does not take into account the costs of arthritis or the influence of physical inactivity on arthritis.

Table 2 presents estimated direct health care costs attributable to physical inactivity in Halifax Regional Municipality. About $23.6 million is spent annually in direct health care costs due to physical inactivity. Theoretically, this is the annual amount that could be saved if all residents of HRM were physically active. Physical inactivity accounts for 22 % of the total direct costs of treating heart disease, stroke, hypertension, colon cancer, breast cancer, type 2 diabetes, and osteoporosis in HRM.

The $23.6 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 $72.2 million. Applying the population attributable fractions from Table 1 for these seven illnesses, physical inactivity would account for over $16 million in hospital, physician and drug costs alone.

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 taken as contributions to prosperity and wellbeing. In the Genuine Progress Index, by contrast, the $23.6 million in health care costs attributable to physical inactivity is counted as a cost, not a gain to the economy. If all HRM residents were physically active, the $23.6 million would presumably be available to be spent on more productive activities, including sport and recreation, which contribute to wellbeing.

The costs calculated for Nova Scotia in this report are considerably lower than those in GPINS, because we used the lower physical inactivity rate (48% from CCHS in 2003, compared with 62% from the CFLRI in 2000). In addition, since EBIC 98 and Katzmarzyk ON were published after the GPINS report, we used percentages from these reports to derive estimates for the costs of specific diseases from the disease categories provided by EBIC 98.

Table 2. Health Care Costs for Chronic Diseases Linked to Physical Inactivity in HRM ($C2003 thousands), and Estimated Direct Economic Cost of Physical Inactivity

Disease	Hospital	Doctor	Drugs	Research	Other	Total Direct	Direct Cost Due to Inactivity*
Coronary heart disease	19,752.4	2,392.8	7,342.9	10.7	13,569.4	43,068.2	12,898.9
Stroke	11,090.7	678.4	1,802.0	3.8	6,244.5	19,819.4	3,165.2
Hypertension	1,383.2	852.1	4,737.7	142.0	3,272.9	10,387.9	1,658.9
Colon cancer	2,924.7	325.9	308.3	61.7	1,665.5	5,286.1	844.2
Breast cancer	3,601.6	401.4	379.7	75.9	2,051	6,509.6	565.0
Type 2 diabetes	1,021.0	374.3	834.9	29.2	1,039.4	3,298.9	526.8
Osteoporosis	7,277.5	1,801.9	2,919.4	27.9	5,532.3	17,559	3,894.6
Total	**47,051.1**	**6,826.9**	**18,325**	**351.2**	**33,374.9**	**105,929.1**	**23,553.7**

* Costs attributable to physical inactivity in the last column are calculated by multiplying the total direct costs of each disease in the previous column by the PAFs in Table 1.

Sources: Katzmarzyk et al 2000, Canadian Medical Association Journal; Health Canada 2002,The Economic Burden of Illness in Canada 1998; Health Canada 1999, Statistical Report on the Health of Canadians; National Cancer Institute of Canada, Canadian Cancer Statistics 2004; Health Canada 1997, The Economic Burden of Illness in Canada 1993.

As noted above, Katzmarzyk and his colleagues omit estimates of mental illness costs attributable to physical inactivity. 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. It is estimated that depression will rank second only to heart disease as the leading cost of disability by the year 2020.[92] Disability claims for mental health (especially depression) have overtaken cardiovascular disease as the fastest growing category of disability costs in Canada.[93]

Mental illness costs Nova Scotia $175.4 (C$2003) million in direct health care expenditures.[94] If we assume that 40.37% of these costs occur in HRM (based on proportion of population), then mental health care in HRM would cost the province $70.8 million a year. We have not adjusted these numbers for incidence, as the 2000/01 CCHS reveals that 8.3% of Capital Health District residents are at probable risk of depression, compared to 8.7% of Nova Scotians – a difference that is not large enough to be statistically significant.[95] If just 5% of these costs could be avoided

[92] Cambridge, M.A., C.J.L. Murray and A.D. Lopex (Eds.) 1996. The Global Burden of Disease: A Comprehensive Assessment of Mortality and Disability from Diseases, Injuries and Risk Factors in 1990 and Projected to 2020. Harvard University Press.
[93] Wilson, M., R. Joffe and B. Wilkerson 2002. The Unheralded Business Crisis in Canada: Depression at Work. Toronto: Global and Business Economic Roundtable on Addiction and Mental Health.
[94] Health Canada 2002. The Economic Burden of Illness in Canada 1998 op.cit.
[95] Statistics Canada Health Indicators, Catalogue no. 82-221-XIE, available at: http://www.statcan.ca/english/freepub/82-221-XIE/00604/tables/html/1296.htm

through physical activity that reduces the incidence of depression, anxiety, and stress, then $3.5 million a year in mental health care costs might be ascribed to physical inactivity. Including a conservative estimate for mental illness costs would therefore raise the estimate of total direct health expenditures due to physical inactivity in HRM to $27.1 million annually.

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 a very conservative estimate based on the NPHS results linking depression to physical inactivity. 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

The PAFs used for direct costs were also used to estimate the indirect costs.

Indirect Cost Calculations

While GPINS calculated costs for indirect productivity losses due to premature mortality and disability for each disease category, Katzmarzyk ON simply used the total of indirect costs. Here we have chosen to separate out the indirect costs for premature death and disability, which allows for more in-depth analysis, and in some cases is quite illuminating. Indirect productivity losses due to premature mortality and disability for each of the main diseases linked to physical inactivity are estimated as follows.

For Nova Scotia, EBIC 98 online provides total indirect costs (premature death; short-term disability; and long-term disability) for the major categories of disease, including cardiovascular, cancer, musculoskeletal, and endocrine disorders, but does not provide costs for the specific disease categories within these classifications that are particularly associated with physical inactivity (coronary heart disease, hypertension, stroke, colon cancer; breast cancer; type 2 diabetes, and osteoporosis). EBIC 98 figures provide a more detailed breakdown of these indirect costs for specific diseases at the national level, but not for the provinces.

Therefore, in order to estimate the indirect costs of these specific diseases in Nova Scotia, we rely on the national ratios of indirect costs of specific diseases to indirect costs for the wider disease category to extrapolate indirect costs for Nova Scotia. When the ratios are not available in EBIC 98, we refer to EBIC 93. When a ratio is unavailable in EBIC 98 or EBIC 93, we use the general rates from Katzmaryzk ON. While this method is less than ideal, it provides a more complete picture of costs than if indirect costs were omitted entirely.

Coronary Heart Disease, Stroke and Hypertension

At the national level (EBIC 98), the costs of premature death caused by coronary heart disease and stroke are 58.7% and 15.2%, respectively, of the total costs of premature death attributed to cardiovascular disease. For hypertension, there is no such breakdown of premature death costs in either EBIC 93 or EBIC 98. Due to the small number of total deaths attributable to hypertensive disease in HRM (12 in 2002), we have not included a cost estimate for premature deaths attributable to hypertension in Table 3 below.

For short-term disability costs due to coronary heart disease and stroke, there is no ratio available, and we have used the ratios from Katzmaryzk ON (42.8% and 9.9% respectively). For short-term disability costs due to hypertensive diseases, we used the percentage from Katzmaryzk ON for total indirect costs attributable to hypertension (9.2% of total cardiovascular costs). Hypertension is a disabling disorder, even though it rarely causes death directly.

The cost of long-term disability due to coronary heart disease is 18% of the cost of long-term disability due to all cardiovascular diseases (EBIC 98, total of acute myocardial infarction and ischaemic heart disease). The cost of long-term disability due to stroke is 13.2 % of long-term disability costs for all cardiovascular disease (EBIC 98), and the cost of hypertension is again estimated at 9.2% of the total costs of long-term disability attributable to cardiovascular diseases (Katzmaryzk ON).

Breast Cancer, Colon Cancer

Since the proportion of premature death costs from cancer attributable to breast cancer and colorectal cancer are presented in EBIC 98, we have used these percentages rather than using the incidence rates as we did for direct costs. Nationally, breast cancer and colorectal cancer accounted for 10% and 9.1 %, respectively, of the total costs of premature death from cancer. Since colon cancer represents 67.1% of colorectal cancer cases, we used 67.1% of 9.1%, or 6.1% for colon cancer. For short-term and long-term disability we have used the Nova Scotia incidence rates for colon cancer and breast cancer, as we did with the direct cost calculations.

Type 2 Diabetes

Nationally (EBIC 98), diabetes accounted for 72.4% of the costs of premature deaths from endocrine diseases. As with direct costs, we have allocated 92.5% of the indirect diabetes costs to Type 2 diabetes. Therefore, 67% of the costs of premature deaths due to endocrine disorders are attributed to Type 2 diabetes.

For short and long-term disability, national figures provide no breakdown, so we used the EBIC 93 ratio of total indirect costs from diabetes to total indirect costs from endocrine related diseases, which is 26.8%.

Osteoporosis

At the national level, costs for premature death, short-term disability, and long-term disability due to osteoporosis are not provided, and therefore we estimate these costs as with the direct costs, at 30.3% of these costs for the musculoskeletal category.

Table 3 presents estimates for indirect productivity losses due to premature mortality and disability for each of the diseases that are related to physical inactivity. 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 $44.7 million annually in productivity losses. In other words, the HRM economy would be worth $44.7 million more each year than it currently is if it had the productive services of the hundreds of HRM residents disabled or killed prematurely by a sedentary lifestyle. When direct medical costs and economic productivity losses are added, Table 4 shows that the total economic burden of physical activity to HRM exceeds $68 million annually. This amounts to $180 per person per year in HRM.

Productivity losses due to mental illness that is attributable to physical inactivity would add an estimated $5.7 million to the indirect costs in Table 3, again on the assumption that 5% of mental illness could be avoided through physical activity.[96] Added to the estimated $3.5 million in direct health care expenditures on mental illness that can be attributed to physical inactivity, the total economic cost of mental illness attributable to physical inactivity in HRM can be estimated at $9.2 million annually. This increases the total economic cost of physical inactivity in HRM to $77.4 million annually.

Table 3. Productivity Losses due to Physical Inactivity ($C2003 thousands), and Total Economic Costs of Physical Inactivity in Halifax Regional Municipality

Disease	Premature Death	Short-term Disability	Long-term Disability	Total Indirect	Total Indirect from Physical Inactivity
Coronary Heart Disease	71,322.7	1,047.1	7,261.9	79,631.7	23,849.7
Stroke	18,448.7	241.9	5,319.7	24,010.3	3,834.5
Hypertension	NA	84.6	1,395.4	1,480	236.4
Colon Cancer	10,096.3	171.8	1,264.1	11,532.2	1,841.7
Breast Cancer	17,811.6	211.5	1,556.7	19,579.9	1,699.5
Type 2 Diabetes	3,492.4	48.3	978.7	4,519.5	721.8
Osteoporosis	600.6	3,156.8	52,492.8	56,250.3	12,476.3
Totals	**121,772.5**	**4,962.1**	**70,269.3**	**197,003.9**	**44,659.9**

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

Table 4. Total Direct and Indirect Costs of Physical Inactivity in HRM ($C2003 thousands)

Disease	Direct	Indirect	Total
Coronary Heart Disease	12,898.9	23,849.7	36,748.7
Stroke	3,165.2	3,834.5	6,999.5
Hypertension	1,658.9	236.4	1,895.4
Colon Cancer	844.2	1,841.7	2,685.7
Breast Cancer	565	1,699.5	2,264.5
Type 2 Diabetes	526.8	721.8	1,248.8
Osteoporosis	3,894.6	12,476.3	16,371.3
Total	**23,553.7**	**44,659.9**	**68,213.6**

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

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 HRM residents were physically active; and
2) age at death, which determines the potential years of life lost due to physical inactivity.

Table 5 identifies the first of these two variables explicitly by applying the population attributable fractions for physical inactivity to five key illnesses. Osteoporosis and hypertension 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.

Table 5 shows that if all HRM residents were physically active, life expectancy could be increased in the province and 200 premature deaths could be avoided each year. This is 7 % of all deaths among HRM residents. Coronary heart disease shows the greatest percentage of deaths attributable to physical inactivity.

Katzmarzyk and his colleagues (Katzmarzyk ON) 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. The GPINS study found that 711 premature deaths in Nova Scotia in 2001 were due to physical inactivity, which represented 9.2% of all deaths in Nova Scotia.

Table 5. Number of Deaths Attributable to Physical Inactivity, Halifax Regional Municipality, 2002

Disease	# of deaths	% of total HRM deaths	Deaths attributable to physical inactivity	% of deaths attributable to physical inactivity (= PAF)
Heart disease	464	16.5%	139	30%
Stroke	177	6.3%	28	16%
Colon cancer	100	3.6%	16	16%
Breast cancer	61	2.2%	10	16%
Diabetes 2[97]	78	2.8%	7	9%
Deaths in HRM, all causes	**2,804**		**200**	**7%**

Sources: Katzmarzyk et al., *Canadian Medical Association Journal* 163 (11), page 1438; and Personal communication, Walter Feeney, N.S. Department of Health, July, 2004.

[97] 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 5 counts only those deaths directly attributable to diabetes 2, and is based on evidence that type 2 diabetes accounts for 92.5% of all diabetes cases.

Table 6 presents estimates of the potential years of life lost (PYLL) annually due to physical inactivity (based on 2002 data). These estimates take into account both the number of deaths , and the average age of death for each disease. PYLL is the number of years of life lost when a person prematurely dies from any cause.

Table 6. Potential Years of Life Lost (PYLL) due to Physical Inactivity, Halifax Regional Municipality, 2002

Disease	PYLL	% of total HRM PYLL	PYLL attributable to physical inactivity	% of PYLL attributable to physical inactivity (=PAF)
Heart disease	1,828	10.5%	547	30%
Stroke	558	3.2%	89	16%
Colon cancer	673	3.9%	107	16%
Breast cancer	525	3%	84	16%
Diabetes 2	257	1%	22	9%
All causes	**17,477.5**		**850**	**4.9%**

Source: Feeney, Walter, Health Information Analyst, Nova Scotia Department of Health, Personal communication, July 14, 2004.

Potential years of life lost were calculated by Mr. Walter Feeney of the Nova Scotia Department of Health. Mr. Feeney provided the following explanation of his methodology:

> "This information is gathered on the death certificate as the underlying cause of death. PYLL is the number of years of life lost when a person prematurely dies from any cause. PYLL is calculated by taking the median of each age group and subtracting from 75 and then multiplying by the number of deaths in that age group. The standardized rate of PYLL per 100,000 is the calculated PYLL divided by the population, of the given area, under 75 years of age. The standardized rate shows the PYLL for the average person, of people with the given condition, under 75 years of age for the given area. A zero simply means that for the given time period there were no deaths attributed to that disease for anyone under the age of 75."[98]

Therefore, the death of a younger person results in greater potential years of life lost than that of an older person.

Table 6 shows that HRM residents each year lose about 850 potential years of life due to physical inactivity. This constitutes 4.9% of all potential years of life lost each year in the municipality due to all causes. If all HRM residents were physically active, the municipality's society and the economy would benefit from an additional 850 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

[98] Feeney, Walter, Health Information Analyst, Nova Scotia Department of Health, personal communication, July 14, 2004.

be considerably larger. The GPINS study found that 2,224 potential years of life were lost in Nova Scotia in 2001 due to physical inactivity. This amounted to 6.5% of all potential years of life lost in Nova Scotia that year.

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 based on a reduction of 10% in the prevalence of inactivity. This is in line with the 2003 public health objective proclaimed by Canadian federal, provincial, and territorial governments to achieve a further 10% reduction in physical inactivity by 2010.[99] A reduction in physical inactivity of 10% in HRM would result in an inactivity rate of 43.2%, still well above the 34% level of British Columbia (10% of 48% is 4.8%, subtracted from 48% = 43.2%).

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 HRM cost estimates above (including mental health) yields estimates of savings as follows:[100]

- Hospital, physician, and drug costs $1.0 million less per year
- Total direct health care costs $1.65 million less per year
- Economic productivity gains (avoided early death and disability) $3.1 million less per year
- Total annual economic savings $4.75 million per year

This amounts to a reduction in health care costs due to physical inactivity of 7%. A 10% reduction in physical inactivity could also save 14 lives a year in HRM, and avoid 59 potential years of life lost annually.

Needless to say, even a 43% rate of physical inactivity is very high, and HRM may choose to aspire in the short term to British Columbia's 34% inactivity rate, and in the longer term to considerably lower rates of inactivity. 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, and through the promotion of development alternatives that encourage walking and bicycling, is very large indeed.

Katamarzyk 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."*[101]

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[99] Canadian Fitness and Lifestyle Research Institute 2004. Increasing Physical Activity: Assessing Trends from 1998-2003.

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

[101] Katzmarzyk et al., 2000, op. cit., page 1439.

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