DATA ANALYSIS OF FITNESS AND PERFORMANCE CAPACITY

Results from the 1981 Canada Fitness Survey and the 1988 Campbell Survey on Well-Being in Canada

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November 1994

Suggested citation: Craig, C.L., Beaulieu, A., and Cameron, C. (1994). *Data Analysis of Fitness and Performance Capacity: Results from the 1981 Canada Fitness Survey and the 1988 Campbell Survey on Well-Being in Canada*. Ottawa: Canadian Fitness and Lifestyle Research Institute.

TABLE OF CONTENTS

INTRODUCTION

This report came about through a request by the Fitness Directorate of Health Canada to examine the following issues:

- the physical functional capacity (or fitness) of Canadians, with trend information as well as information on differences between age-sex groups;

- the link between fitness and physical activity patterns, with a breakdown of fitness measures for people who are active, moderately active, and inactive in their leisure time;

- the impact of activity patterns, with a brief commentary about whether the Canadian population is fit or unfit, whether it is getting better or worse, and what the potential consequences can be for the health care system.

The report's structure follows this order, first highlighting the fitness patterns and trends of Canadians, then linking fitness to physical activity patterns, and finally evaluating the impact of fitness and activity on the health care system. Both fitness and physical activity data can be extracted from the 1981 Canada Fitness Survey and the 1988 Campbell Survey on Well-Being in Canada. To this day, the two surveys remain the authoritative sources of information concerning the fitness and physical activity patterns of the Canadian population.

While the report focuses on the physical capacity or fitness of Canadians, the impact of fitness levels on the health care system cannot be measured without looking at physical activity. Fitness per se cannot be undertaken directly—it must be enhanced indirectly through physical activity. For this reason, the last part of the report examines the implications for health care interventions by considering physical activity first and foremost.

It is hoped that the report will provide all the relevant information about Canadians' fitness and physical activity patterns to facilitate the important decisions that need to be made with respect to the renewal of the health care system.

EXECUTIVE SUMMARY

Physical Functional Capacity: Normative Trends

- Cardiovascular endurance appears to have *increased* during the seven-year period separating the 1981 Canada Fitness Survey and the 1988 Campbell Survey on Well-Being in Canada, more so in women than in men. The only group showing a *decrease* in cardiovascular endurance consists of males between the ages of 10 and 19. Refinements of the method used to predict cardiovascular endurance for more fit individuals may account for some of the increase noted, so it cannot be concluded that the increases are statistically significant.

- Up to 39 years of age, most Canadians meet the optimal fitness standards set by Blair et al. (1989).

- Approximately 20% of women in the 40–49 age group barely meet the standard of 31.5 $mL \cdot kg^{-1} \cdot min^{-1}$. Among women aged 50–59, at least 60% do not measure up to the standard. As of age 60, no women meet the standard. Altogether, 2.2 million women face an increased health risk because of poor cardiovascular endurance.

- Although more 50–59-year-old men meet the fitness standard than women of the same age, the picture remains grim: at least 40% have a VO_2 max below 35 $mL \cdot kg^{-1} \cdot min^{-1}$. None of the 60–69-year-old men meet the optimal fitness standard. Altogether, 1.8 million men face an increased health risk because of poor cardiovascular endurance.

- Women are generally more flexible in the lower back area than men, particularly among the oldest age groups, where women reach 10 cm farther than men on average. Over half the men between the ages of 40 and 49, and as many as 8 out of 10 men aged 60–69, are unable to reach their toes.

- Flexibility decreased slightly between the 1981 and the 1988 surveys, and significantly so for women aged 40–49. The next largest decreases occurred for both men and women aged 50–59.

- Men show greater strength on average than women, in all age groups. Strength values peak at 20–29 in men and at 30–39 in women. The subsequent decrease is more noticeable in men than it is in women. Between 1981 and 1988, a slight decrease in strength occurred for most male and female groups aged 20 onwards. While these decreases in median scores are not significant, continued reductions could result in a larger number of older adults facing activity limitations later on in life.

- When sit-ups or push-ups are used as the indicator of muscular endurance, men show greater endurance than women, in all age groups. Muscular endurance decreases with age, from its maximum at 10–19 years. Endurance remained at the same level between 1981 and 1988, except for the youngest and oldest age groups: teenagers show a decrease in muscular endurance between the two

surveys, as do women aged 60–69. In fact, more than half of women in that older age group cannot perform a single sit-up.

- Weight tends to increase with age group for both men and women. A slight drop is observed in women over the age of 60. There seems to have been an increase in measured body weight between 1981 and 1988, for most age groups and for both males and females. For instance, men weighed 72 kilograms on average in 1981 and 76 kilograms in 1988. Women's average weight was 58 kilograms in 1981 and 61 kilograms in 1988. The largest increases occurred in the youngest and oldest age groups, for both men and women. These differences are not significant.

- Height peaks around age 20–29 for both men and women, with the height of successive age groups decreasing slightly thereafter. The measured height of Canadian men and women has more or less remained the same between the 1981 Canada Fitness Survey and the 1988 Campbell Survey on Well-Being in Canada. Men's average height is 174 cm for both years, while women's is 160 cm in 1981 and 161 cm in 1988.

- Body mass index, which takes both height and weight into account, is considered normal for adults when it is between 20 and 25. More than half the men between the ages of 40 and 69 and more than half the women aged 50–59 have a body mass index exceeding 25. They may be at risk of developing hypertension, diabetes, and cardiovascular disease because of excessive weight.

- Between 1981 and 1988, increases in body mass index occurred in the oldest age groups, namely women aged 50–69 and men aged 50-59. While the change in body mass index *values* is not significant, the change in *percentage* of overweight Canadians is significantly different, especially among men.

- Women tend to have higher sums of skinfolds than men, which reflects their naturally higher proportions of fat. However, more than half the women aged 50–59 tend to be at risk since their skinfolds exceed 85 mm, which is the threshold of unacceptable values for women of that age.

- Men's and women's skinfold values were higher by 1988, indicating an overall increase in fatness among Canadians between the two surveys. The change in the amount of fat is not in itself significant, but coupled with the increased number of Canadians classified as overweight by the body mass index, it is a cause for concern.

- Men tend to have a higher abdominal fat content than women. The waist-to-hip ratio increases with age, especially for men. Although no significant change occurred between 1981 and 1988, more than 50% of men aged 50 and older are considered at risk because of excessive abdominal fat.

Relationship Between Fitness and Physical Activity Level

- For 80% of Canadians, VO_2 max decreases slightly, but significantly (3 $mL \cdot kg^{-1} \cdot min^{-1}$), with a decrease in energy expenditure.

- Flexibility appears unaffected by physical activity level. Among Canadians aged 45 and older, highly active people in the most flexible quintile appear more flexible than their less active counterparts. While this result is not significant, it raises the possibility that physical activity may have a protective effect against decreases in flexibility for older Canadians.

- Grip strength is generally unaffected by the energy expenditure level. Among the strongest Canadians aged 25 and older, the least active showing *more* strength than the most active. Genetics could well play a role in maintaining strength in that 20% of the population, but the relative choices of activities may also explain the difference.

- Muscular endurance appears to decrease slightly with lower activity levels, whether push-ups or sit-ups are used as the indicator of endurance.

- Body mass index does not seem to be affected by activity level for most quintiles. In the highest body mass quintile, however, people are clearly more overweight when they are not active.

- By contrast, slight increases in skinfolds are observed in less active people, in all quintiles. This merits special attention, particularly where women are concerned, because they are more likely to show excessive skinfolds.

Relationship Between Fitness and Physical Activity Change

- As many as 80% of people who maintained their activity level seem to have a slightly, but significantly, better VO_2 max than those who started or resisted activity between 1981 and 1988.

- The link between change in physical activity and flexibility is not significant.

- For 40% of Canadians, there is a significant increase in grip strength between non involvement in physical activity and high adherence.

- Stronger adherence patterns are also accompanied with significantly higher muscular endurance levels.

- Those who resisted physical activity between 1981 and 1988 are significantly more overweight than those who maintained their participation in physical activity.

- People who maintained their physical activity levels between 1981 and 1988 are more likely to have significantly lower sums of skinfolds than people who started, lapsed from, or resisted an active lifestyle.

Impact of Activity Patterns on the Health Care System

- Twenty percent of the “asymptomatic” population (not showing symptoms of serious health conditions) runs a high risk of premature death. This represents 1.28 million men and 1.31 million women in Canada. Men in the least fit quintile have 3.44 times as much risk of dying prematurely as men in the most fit quintile. Women in the least fit quintile run an even greater risk: they incur 4.65 times as much risk of dying prematurely as women in the most fit quintile.

- Important differences are observed between the optimal fitness group and the high health risk group with respect to a few restrictions in day-to-day activities. Optimally fit people are eight times less likely to have difficulty climbing stairs than people at high health risk. Compared with people who display optimal fitness, twice as many people with elevated or high health risk have trouble standing. Difficulty in bending down is also reported more frequently with lower levels of fitness, as is bending to cut toenails. Even walking 400 metres is reported four times more frequently by people with high health risk than by people with optimal fitness.

- People who achieve optimal fitness therefore have a greater capacity to be independent than people who have a high health risk as a result of their low level of fitness. Since older Canadians are most likely not to achieve the fitness standards, a large portion of the older population is at risk of not being autonomous enough to pursue simple activities of daily living.

- People in the optimal fitness and the elevated health risk groups are more likely to have paid a visit to their physicians in the year preceding the 1988 Campbell Survey on Well-Being in Canada (presumably for regular annual examinations), but much less likely to have seen their physicians three or more times during that year. Likewise, people who most closely meet the fitness standard are less likely to have spent a night in the hospital in the year preceding the survey.

- Compared with people at high health risk, optimally fit people are more likely to rate their health as good or very good. They are also less likely to rate their health as only average or as poor or very poor.

- Optimally fit people are less likely to be current smokers than people at high health risk and are much less likely to have ever smoked.

- Optimally fit people are less overweight than people with elevated or high health risk. In fact, they are half as likely to have excess weight than people in the next category (elevated health risk), significantly less likely to have excess fat, and three times less likely to have a high waist-to-hip ratio.

- Individuals who achieve the optimal fitness standard are four times less likely to be borderline hypertensives than individuals with an elevated health risk. They are five times less likely to be borderline hypertensives than those with a high health risk.

- Studies have shown that physical activity is a cost-effective treatment for borderline hypertension, since it is less expensive and equally effective in lowering blood pressure. Furthermore, Blair and colleagues have shown in a recent article that being fit has a protective effect against premature death for hypertensives. Low-fit hypertensive men face a 4.5 times higher risk of premature death than fit hypertensive men.

- Since Canadians who are optimally fit are less likely to smoke, be obese and show borderline hypertension, it may be doubly important to promote the adoption and maintenance of physically active lifestyles to remove these additional risks as well. It could be argued, for instance, that by moving all people who are now at high health risk into the elevated health risk category, there would be fewer smokers, fewer obese people, and fewer hypertensives.

- There are four recognized primary risk factors of coronary heart disease, namely high blood pressure, high blood cholesterol, cigarette smoking, and physical inactivity. Of the four risk factors, sedentary living is the most prevalent one for coronary heart disease in Canada. Almost 40% of Canadians are not active on a daily basis. Comparatively, 26% smoke cigarettes regularly and 11% have high blood pressure. About 10% may have high blood cholesterol.

- In addition to *prevalence* of a given risk factor, the *risk of disease* associated with that factor must be taken into consideration to determine the overall impact on public health. The relative risk associated with low physical fitness levels exceeds that of all the other factors included in the investigations. Because the prevalence of physical inactivity is also high, the relative impact directly attributable to inactivity for Canadians is higher than the relative impact due to smoking or elevated cholesterol levels.

- Substantial evidence exists that physical activity can increase average life expectancy by as much as two years. The added years of life are not likely to result in costly procedures to treat chronic diseases since physical activity reduces the risk of disease and, in many cases, assists in control and rehabilitation.

- Physical activity has been found to be cost effective for ischaemic heart disease as long as the cost of individuals' time spent exercising was not included along with direct costs like equipment. This is an appropriate assumption for governments—who do not compensate individuals for such time—and for individuals who enjoy or value physical activity.

- Keeler et al. (1989) calculated discounted lifetime costs of physical activity like medical care and sick leave and included lost revenues like taxes on earnings. Increasing physical activity was found to "save" an average of $2,570 ($1,900 U.S. dollars) per person.

- Being active saves almost twice as much per person as being a non-smoker. Moreover, there are about 1.7 times as many inactive Canadians as there are Canadians who smoke. The lifetime estimate of costs avoided could amount to $24.3 billion for inactive Canadians who became active, compared with $7.7 billion for Canadian smokers who stopped smoking.

- Progress can truly be made to encourage more Canadians to be active. Between 1981 and 1991, 8% of Canadians have become active, as demonstrated by the increasing participation levels from the 1981 Canada Fitness Survey to the 1985 General Social Survey, the 1988 Campbell Survey on Well-Being in Canada, and the 1991 General Social Survey.

- A total of $4.4 billion in costs have been avoided as a result of the successful increase in the rate of physical activity over the 10-year period from 1981 to 1991. These avoided costs represent dollars that do not have to be spent from the public purse, freeing the money to be spent in other activities essential to the growth of our economy.

DATA ANALYSIS OF FITNESS AND PERFORMANCE CAPACITY:

Results of the 1981 Canada Fitness Survey and the 1988 Campbell Survey on Well-Being in Canada

Fitness, or physical functional capacity, is a composite of several attributes related to skill and health. Athletes provide the best demonstration of skill-related fitness. They mesmerize the crowds with their agility, balance, coordination, speed, power, and reaction time. Health-related fitness, on the other hand, is not the prerogative of athletes. Since it has the potential of enhancing the health of the entire population, it can be pursued to great benefit by everyone.

Originally developed as a motivational tool, the Canadian Standardized Test of Fitness was devised to assess health-related fitness. Through this series of tests, fitness appraisers assess the five attributes of health-related fitness: cardiovascular endurance, flexibility, muscular strength, muscular endurance, and body composition. Cardiovascular endurance, though often equated to fitness, constitutes but one component of physical fitness.

The Canadian Standardized Test of Fitness has been the tool of choice for assessing the physical fitness of the Canadian population in two large-scale, national surveys conducted in the 1980s. The 1981 Canada Fitness Survey collected data on 23,000 Canadians. Its longitudinal follow-up, the 1988 Campbell Survey on Well-Being in Canada, collected information on one fifth of the 1981 sample—approximately 4000 Canadians. These two household surveys consisted of a respondent-completed questionnaire and a fitness test, both of which were administered in the respondents' homes by teams of qualified fitness appraisers.

Part I of this report gives an overview of the fitness levels of Canadians, highlighting the changes that have occurred between 1981 and 1988. In Part II, the fitness levels of Canadians are tabulated against their physical activity levels. The final part, Part III, provides a brief commentary on the impact of the fitness levels of Canadians on their health care system.

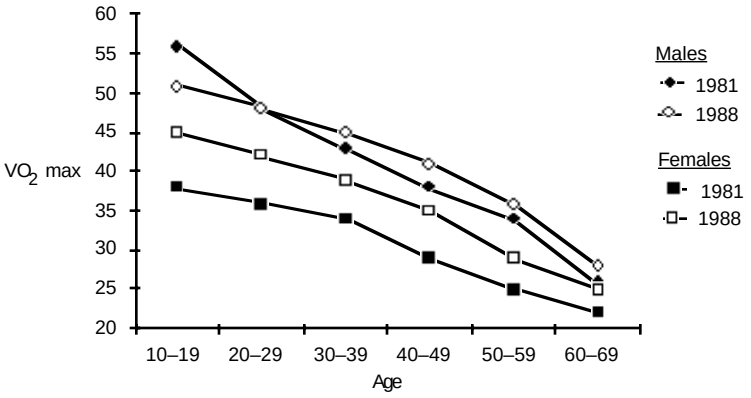
I. PHYSICAL FUNCTIONAL CAPACITY: NORMATIVE TRENDS

1. Cardiovascular Endurance

Whereas most other fitness measures are maintained or show slight decreases between 1981 and 1988, cardiovascular endurance appears to have *increased* during the seven-year period separating the two surveys, more so in women than in men. Figure 1 shows that the only group showing a *decrease* in cardiovascular endurance consists of males between the ages of 10 and 19.

Refinements of the method used to predict cardiovascular endurance for more fit individuals may account for some of the increase noted. Therefore, it cannot be concluded that the increases are statistically significant.

FIGURE 1
Change in VO_2 max (50th percentile) between 1981 and 1988, Age 10+



How good are these levels of cardiovascular endurance from a public health view point? A landmark study reported by Blair and colleagues in 1989[1] provides standards against which these values can be compared. The study classified participants according to fitness quintiles (five groups with an equal number of subjects, ranging from least fit to most fit). For each quintile, the researchers estimated the age-adjusted, all-cause mortality rates per 10,000 person-years.

They found not only that the least fit quintiles had the highest risk, but also that this risk decreased dramatically between the least fit and the second least fit quintiles, as shown in Table 1. In men, for example, the age-adjusted death rate went from 64 per 10,000 in the least fit quintile to 26 per 10,000 in the second least fit quintile—almost a threefold reduction! Compare this difference with the difference observed between the second least fit and the most fit quintiles (26 versus 19 deaths per 10,000), and it becomes striking that only a moderate level of fitness is required to bypass the highest risk.

TABLE 1
Age-adjusted all-cause death rates per 10,000 person-years

Quintile	Men	Women
1 (low)	64	40
2	26	21
3	27	12
4	22	7
5 (high)	19	9

Adapted from Blair et al. (1989)

In women, the age-adjusted death rate was reduced by half from the least fit quintile to the second least fit quintile (40 versus 21 deaths per 10,000), and almost by half again between the second least fit quintile and the next one up (21 versus 12 deaths per 10,000). Little change occurred from this point to the most fit quintile.

From these results, Blair et al. established the optimal fitness level at VO_2 max values of 35 mL•kg^{-1}•min^{-1} for men and 31.5 mL•kg^{-1}•min^{-1} for women. These values can be used as standards against which we can assess the cardiovascular endurance levels of Canadians. Figures 2 and 3 show a quintile distribution of VO_2 max for all age groups surveyed in the 1988 Campbell Survey on Well-Being in Canada. The columns are drawn against the standards proposed by Blair et al. for men and women.

FIGURE 2
Differences between quintile cutoffs of VO_2 max and optimal VO_2 max value for men (1988), Age 10+

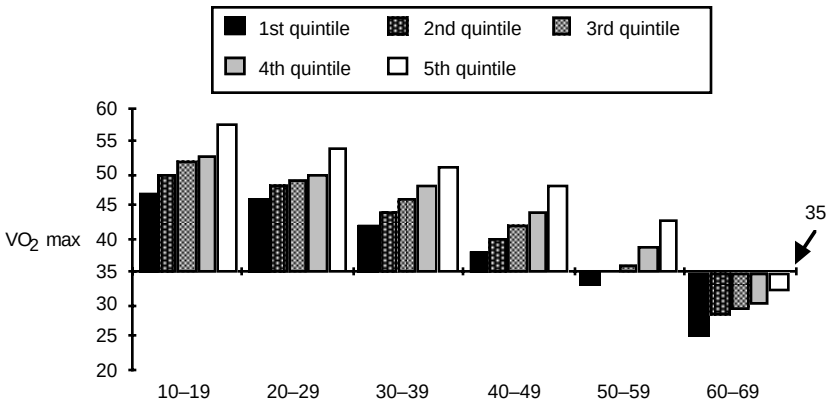
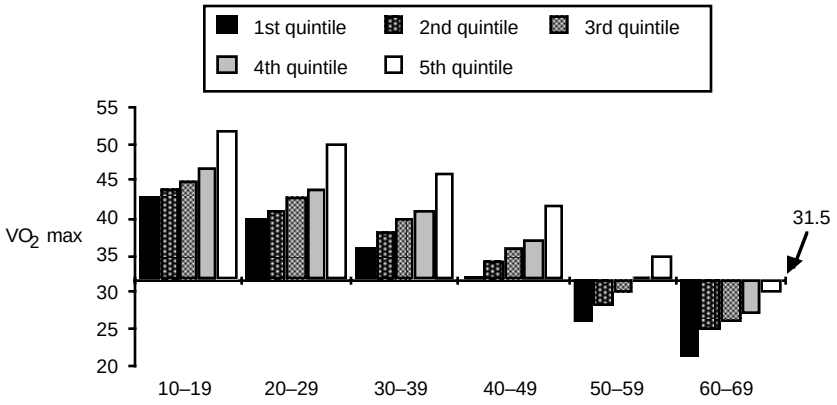


FIGURE 3
Differences between quintile cutoffs of VO_2 max and optimal VO_2 max value for women (1988), Age 10+



Up to 39 years of age, most Canadians meet the optimal fitness standards set by Blair et al., regardless of the cardiovascular endurance quintile to which they are assigned. In the 40–49 age group, women assigned to the lowest quintile of cardiovascular endurance barely meet the standard of 31.5 mL•kg^{-1}•min^{-1}. Beyond that age, significant numbers of Canadian women do not exhibit optimal fitness. Among

women aged 50–59, the three lowest quintiles do not meet Blair et al.'s standard. This is equivalent to 60% of women in that age group, or 749,000 women. As of age 60, no women meet the standard. Women facing increased risk in both age groups account for 20% of all Canadian women, or 2.2 million women.

Similar observations can be made for men. Although more 50–59-year-old men meet the fitness standard than women of the same age, the picture remains grim: at least two quintiles, or 40%, have a VO_2 max below 35 $mL \cdot kg^{-1} \cdot min^{-1}$. As was observed for women, none of the 60–69-year-old men meet the optimal fitness standard. Altogether, men at risk in those two age groups account for 17% of the total male population in Canada. That is, 1.8 million Canadian men do not achieve the cardiovascular endurance level required to reduce their risk.

2. Flexibility

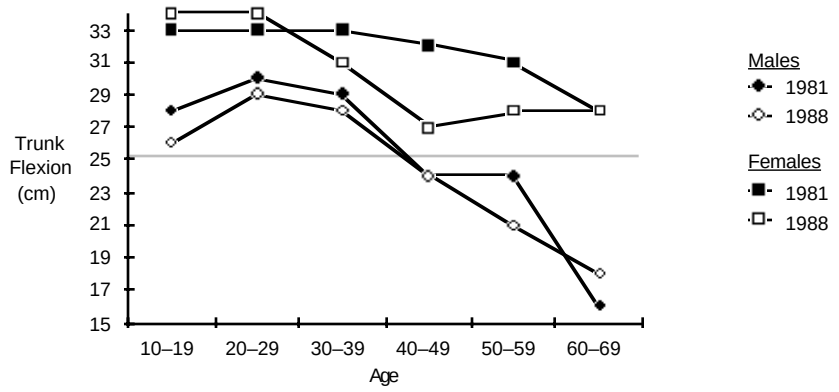
Flexibility is another important component of fitness and functional capacity. It is essential for performing many daily tasks. Older people, in particular, need to be flexible to accomplish common tasks easily.

Figure 4 shows that women are generally more flexible in the lower back area than men. On the flexometer test, they could reach 5 cm farther than men could, in both 1981 and 1988. This discrepancy is particularly apparent among the oldest age groups, where women reach 10 cm farther than men on average.

Flexibility decreased slightly between the 1981 and the 1988 surveys, however, and significantly so for women aged 40–49. The next largest decreases occurred for both men and women aged 50–59.

Poor flexibility may lead to difficulty in performing everyday tasks, such as tying shoelaces. The flexometer test shows that when seated, over half the men between the ages of 40 and 49, and as many as 8 out of 10 men aged 60–69, are unable to reach their toes.

FIGURE 4
Change in trunk flexibility (50th percentile) between 1981 and 1988, Age 10+



3. Strength and Muscular Endurance

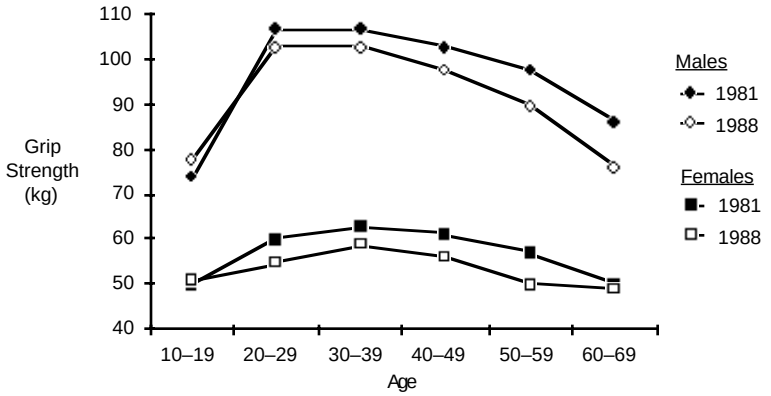
Muscular strength and muscular endurance involve muscles in different ways. Muscular strength reflects the maximum tension exerted by the muscle during a single contraction. Muscular endurance, on the other hand, reflects the capacity of a muscle to contract repeatedly over a given amount of time.

Even daily activities require a minimal level of muscular strength, and most require good muscular endurance. Cleaning windows, washing floors, painting, gardening, raking leaves, and shoveling snow all require prolonged muscular effort. Individuals whose muscles are not used to contracting repeatedly will tire more easily and will be more exposed to potential injuries or soreness.

Figure 5 shows the trend results as they pertain to the first characteristic of a muscle: exerting tension during a single contraction, or strength. Strength was measured by means of a hand grip dynamometer. While the assessment of total body strength requires a battery of tests, grip strength has been shown to be the best single predictor of total strength. The combined maximum scores for the right and left hand grips are reported in the figure.

As expected, men show greater strength on average than women, in all age groups. Strength values peak at 20–29 in men and at 30–39 in women. The subsequent decrease is more noticeable in men than it is in women. Between 1981 and 1988, a slight decrease in strength occurred for most male and female groups aged 20 onwards. While these decreases in median scores are not significant, continued reductions could result in a larger number of older adults facing activity limitations later on in life.

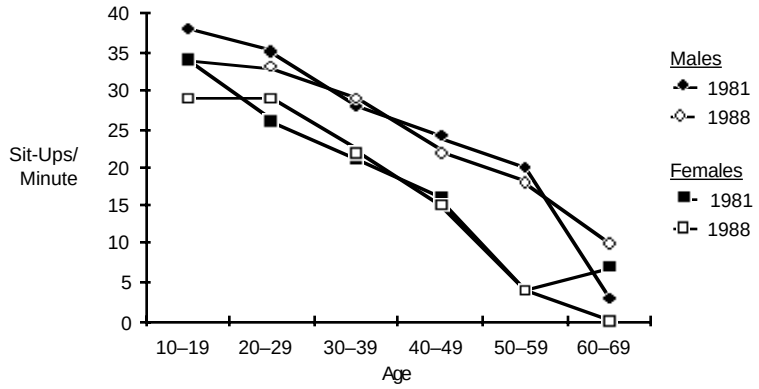
FIGURE 5
Change in grip strength (50th percentile) between 1981 and 1988, Age 10+



Figures 6 and 7 illustrate the second characteristic of a muscle: the ability to sustain repeated contractions, or endurance. The number of sit-ups per minute and the maximum number of push-ups accomplished without interruption give an indication of Canadians' muscular endurance.

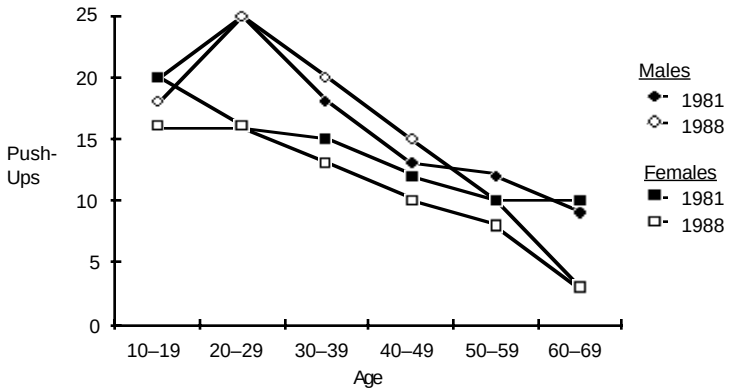
When sit-ups are used as the indicator of muscular strength (Figure 6), men show greater endurance than women, in all age groups. Muscular endurance decreases with age, from its maximum at 10–19 years. Endurance remained at the same level between 1981 and 1988, except for the youngest and oldest age groups. Teenagers show a decrease in muscular endurance between the two surveys, as do women aged 60–69. In fact, more than half of women in that older age group cannot perform a single sit-up.

FIGURE 6
Change in muscular endurance (50th percentile) as estimated by number of sit-ups per minute (1981–1988), Age 10+



A similar pattern is observed when push-ups are used as the indicator of muscular endurance (Figure 7), with decreases between 1981 and 1988 again appearing in the youngest and oldest age groups. In addition, the decline in ability to perform push-ups across successive age groups is steeper in 1988 that it was in 1981.

FIGURE 7
Change in muscular endurance (50th percentile) as estimated by maximum number of push-ups accomplished without interruption (1981–1988), Age 10+



The ability to perform one push-up may also be interpreted as a strength measure; that is, the ability to perform one contraction against body weight. More than 20% of older adults cannot perform a single push-up. This means that they may face limitations in performing activities that require similar levels of strength—pushing open heavily weighted revolving doors, for instance.

4. Body Composition

Body composition is included as a measure of fitness because it is associated with important health consequences. Underweight people can develop serious disorders, just as overweight people are at higher risk of developing hypertension, diabetes, and cardiovascular disease. There are several ways of assessing body composition, the most popular epidemiological approaches being the body mass index, the sum of skinfolds, and the waist-to-hip ratio.

The body mass index is a measure of relative weight for height. Figure 8 shows that weight tends to increase with age group for both men and women. A slight drop is observed in women over the age of 60. There seems to have been an increase in measured body weight between 1981 and 1988, for most age groups and for both males and females. For instance, men weighed 72 kilograms on average in 1981 and 76 kilograms in 1988. Women's average weight was 58 kilograms in 1981 and 61 kilograms in 1988. The largest increases occurred in the youngest and oldest age groups, for both men and women. These differences are not significant.

FIGURE 8
Weight trends (50th percentile, 1981–1988), Age 10+

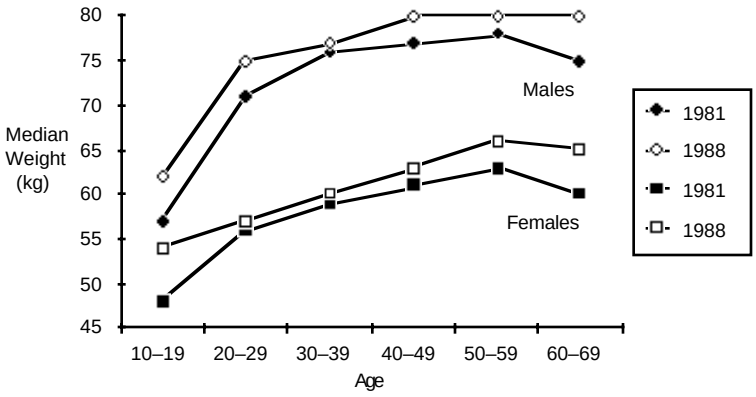
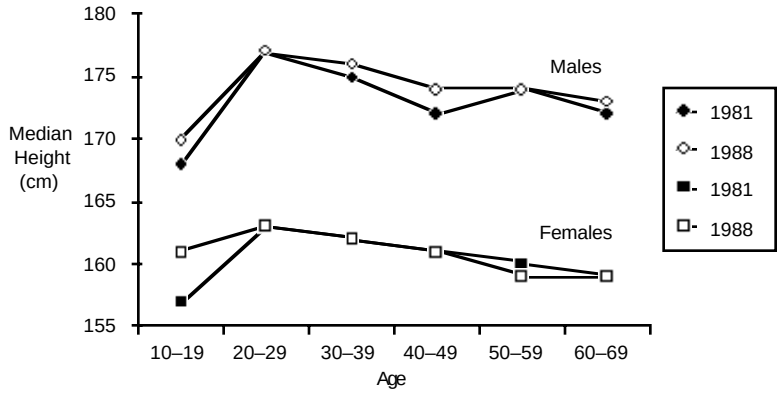


Figure 9 shows that height peaks around age 20–29 for both men and women, with the height of successive age groups decreasing slightly thereafter. The measured height of Canadian men and women has more or less remained the same between the 1981 Canada Fitness Survey and the 1988 Campbell Survey on Well-Being in Canada. Men's average height is 174 cm for both years, while women's is 160 cm in 1981 and 161 cm in 1988. This slight increase is attributable to a height increase observed among 10–19-year-old adolescent girls, but it is not statistically significant.

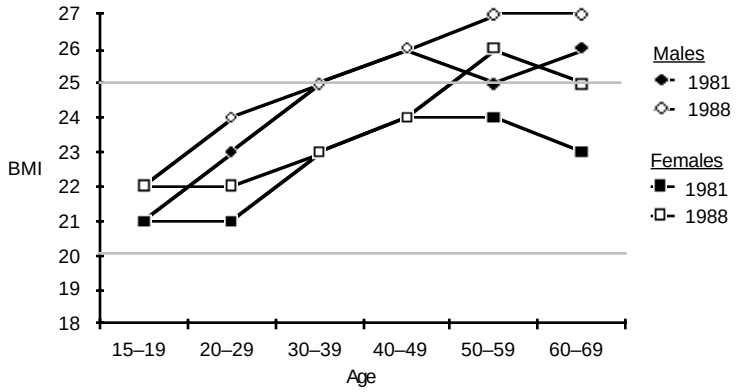
FIGURE 9
Height trends (50th percentile, 1981–1988), Age 10+



Body mass index takes both height and weight into account. It is calculated as weight by height squared (kg/m^2). On a population basis, a body mass index greater than 25 is associated with higher mortality rates. On an individual basis, a high body mass index may be associated with fatness or with well-developed muscularity. A body mass index between 20 and 25 is considered normal for adults—men and women alike.

Figure 10 shows that men tend to have higher body mass indices than women, both in 1981 and in 1988. In addition, more than half the men between the ages of 40 and 69 and more than half the women aged 50–59 have a body mass index exceeding 25. This means that more than half of men and women in those age groups are at risk of developing hypertension, diabetes, and cardiovascular disease because of excessive weight. Between 1981 and 1988, increases in body mass index occurred in the oldest age groups, namely women aged 50–59 and 60–69 and men aged 50-59. While the change in body mass index *values* is not significant, the change in *percentage* of overweight Canadians is significantly different, especially among men. This is consistent with the findings for reported body mass data from the 1990 Health Promotion Survey.[2]

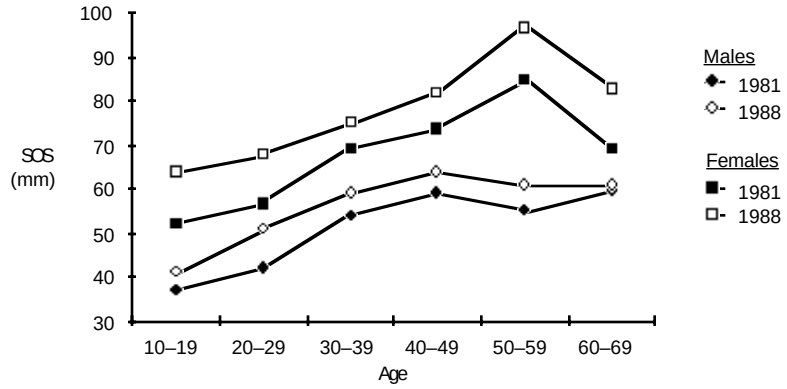
FIGURE 10
Change in body mass index (50th percentile) between 1981 and 1988, Age 15+



Despite its ease of use, the body mass index does not always reflect the true health risk attributable to excessive or insufficient weight. Men, for instance, may have higher body mass indices as a result of muscle weight instead of fat weight. The sum of skinfolds is therefore used in combination with the body mass index to assess the health risk associated with weight. Using skinfold calipers, fitness appraisers measured the triceps, biceps, subscapular, iliac crest, and medial calf skinfolds. The sum of skinfolds shown in Figure 11 is the total of the five skinfolds.

Women tend to have higher sums of skinfolds than men, which reflects their naturally higher proportions of fat. However, more than half the women aged 50–59 tend to be at risk since their skinfolds exceed 85 mm, which is the threshold of unacceptable values for women of that age. In addition, men's and women's skinfold values were higher by 1988, indicating an overall increase in fatness among Canadians between the two surveys.

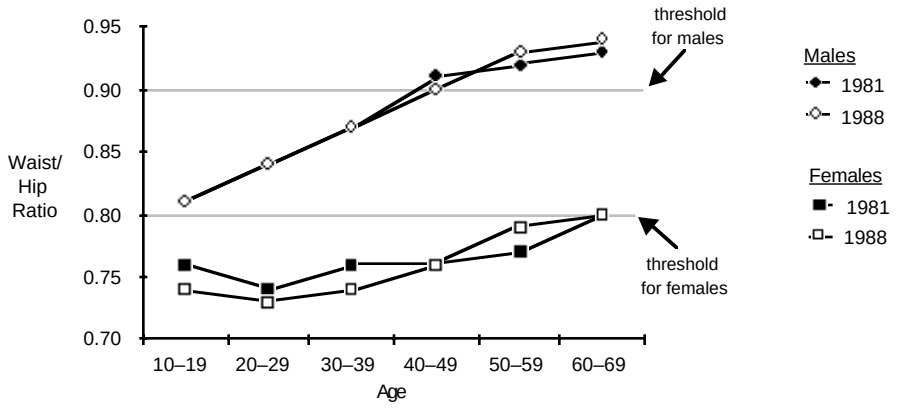
FIGURE 11
Change in sum of skinfolds (50th percentile) between 1981 and 1988, Age 10+



The change in the amount of fat is not in itself significant, but coupled with the increased number of Canadians classified as overweight by the body mass index, it is a cause for concern. The small increases in overall levels of fatness translate into significant increases in the number of Canadians, particularly men, who face an elevated risk of health problems as a result of their weight.

An evaluation of men's waist-to-hip ratio reinforces that concern. Studies have shown the risk of cardiovascular disease to be proportionally related to abdominal fat content—which is reflected by the waist-to-hip ratio. Figure 12 shows that men tend to have a higher abdominal fat content than women. The waist-to-hip ratio increases with age, especially for men. Abdominal girth is judged excessive if the ratio is greater than 0.90 for men and greater than 0.80 for women. Although no significant change occurred between 1981 and 1988, more than 50% of men aged 50 and older are considered at risk because of excessive abdominal fat.

FIGURE 12
Change in waist-to-hip ratio (50th percentile) between 1981 and 1988, Age 10+



II. RELATIONSHIP BETWEEN FITNESS AND PHYSICAL ACTIVITY PATTERNS

Fitness is strongly influenced by genetic factors,[3] but it can be enhanced by physical activity to different degrees in different individuals. Cardiovascular endurance can be improved through aerobic activities, which typically involve the large muscle groups such as those in the arms and legs. Muscular strength and endurance can be increased through resistive and repetitive activities, weight training being perhaps the most common illustration. Flexibility can be enhanced by the gentle stretching of various muscles throughout the body, as is observed in calisthenics.

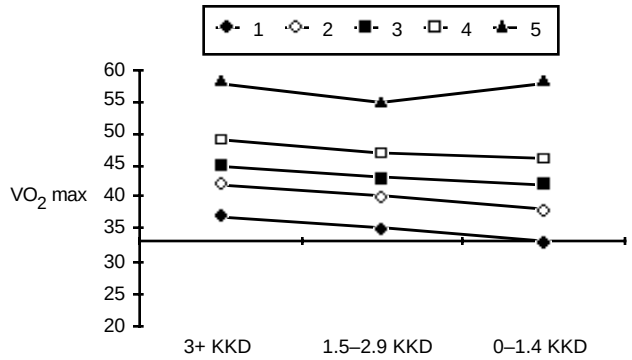
Genetics may largely determine who becomes a professional athlete, but both professional athletes and recreational enthusiasts can push the limits of genetics through physical activity to enhance their fitness levels and, more importantly, their functional capacity or ability to perform day-to-day tasks.

1. Relationship Between Fitness and Physical Activity Level

How much influence does physical activity have over fitness levels? To answer this question, the current analysis links the physical activity and fitness data from the 1988 Campbell Survey on Well-Being in Canada. Physical activity is defined according to the number of kilocalories expended every day for each kilogram of body weight (kcal/kg/day). By this definition, a person expending at least 3 kcal/kg/day is considered highly active whereas another who expends less than 1.5 kcal/kg/day is considered sedentary. Roughly, a high physical activity level is equivalent to walking a total of one hour every day.

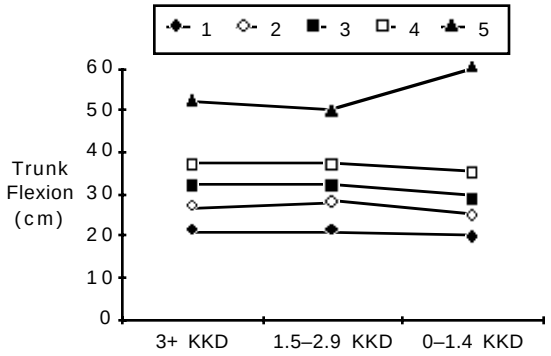
Figure 13 shows the link between energy expenditure and cardiovascular endurance. VO_2 max decreases slightly, but significantly (3 $mL \cdot kg^{-1} \cdot min^{-1}$), with a decrease in energy expenditure, except for the most fit quintile. In this quintile, genetics is perhaps a more determining factor of VO_2 max than physical activity level. A similar pattern holds for all age groups.

FIGURE 13
Link between VO_2 max quintile and level of physical activity defined by energy expenditure (kcal/kg/day), Age 10+



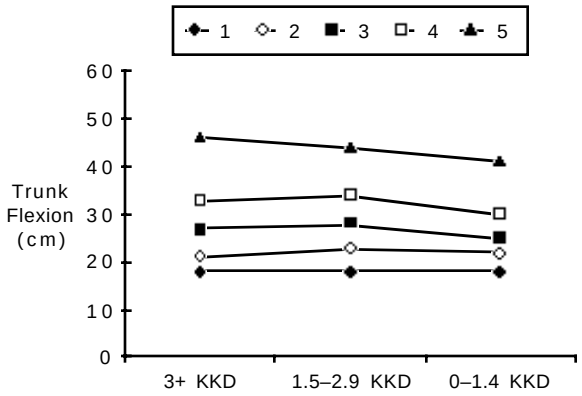
Flexibility, however, appears unaffected by physical activity level (Figure 14). In the most flexible quintile, the most flexible group is observed among sedentary individuals! This unexpected result is caused by the 25–44-year-old age group (data not shown).

FIGURE 14
Link between flexibility quintile and level of physical activity defined by energy expenditure (kcal/kg/day), Age 10+



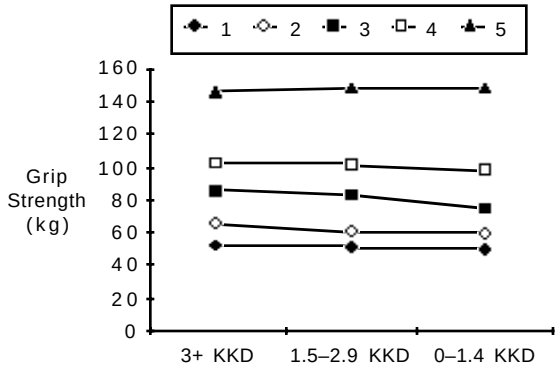
Among Canadians aged 45 and older, by contrast, highly active people in the most flexible quintile appear more flexible than their less active counterparts (Figure 15). While this result is not significant, it raises the possibility that physical activity may have a protective effect against decreases in flexibility for older Canadians.

FIGURE 15
Link between flexibility quintile and level of physical activity defined by energy expenditure (kcal/kg/day), Age 45+



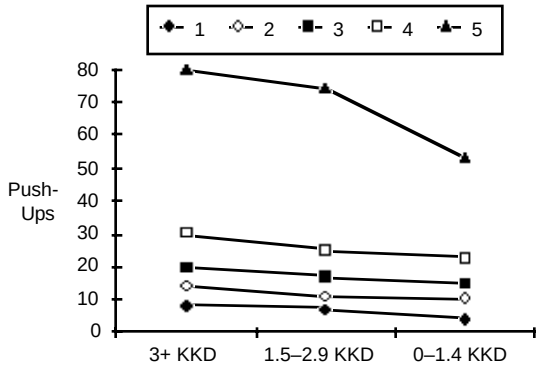
Grip strength is generally unaffected by the energy expenditure level in the total population, as shown in Figure 16. Only the third quintile shows a positive relationship with physical activity.

FIGURE 16
Link between muscular strength quintile and level of physical activity defined by energy expenditure (kcal/kg/day), Age 10+



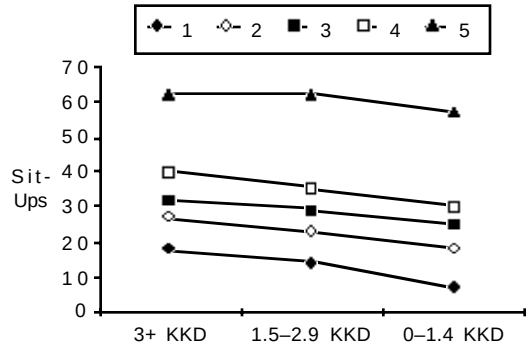
Muscular endurance appears to decrease slightly with lower activity levels. As shown in Figure 17, a significant drop in the number of push-ups is observed between the active and the sedentary in the most “endurant” quintile (quintile 5). The strong effect is attributable to the 25–44-year-old group, since the younger and older age groups show a more moderate decrease in the number of push-ups performed (data not shown).

FIGURE 17
Link between muscular endurance (push-ups) quintile and level of physical activity defined by energy expenditure (kcal/kg/day), Age 10+



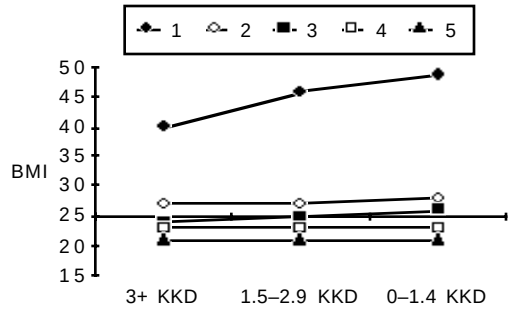
The sit-up test (Figure 18) provides further indication that muscular endurance is affected by physical activity. People who perform more sit-ups tend to be more active, regardless of the quintiles to which they are assigned. Similar patterns hold for all age groups. With this component of fitness, even a moderate effort at being active seems to pay off.

FIGURE 18
Link between muscular endurance (sit-ups) quintile and level of physical activity defined by energy expenditure (kcal/kg/day), Age 10+



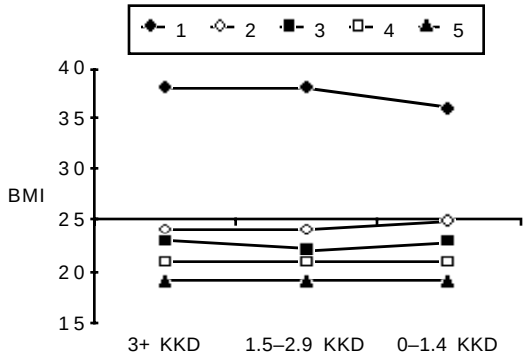
A higher body mass index indicates *lower* body composition fitness. As indicated in Figure 19, body mass index does not seem to be affected by activity level for most quintiles. In the highest body mass quintile, however, people are clearly more overweight when they are not active.

FIGURE 19
Link between body mass index quintile and level of physical activity defined by energy expenditure (kcal/kg/day), Age 15+



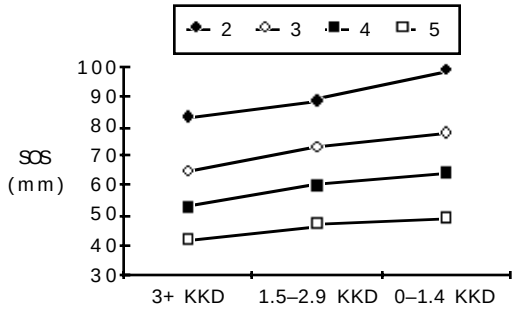
The body mass pattern just described holds for Canadians older than 25. For younger Canadians (Figure 20), the highest body mass quintile does not show physical activity as a significant advantage for maintaining appropriate body weight. In fact, for that age group, none of the quintiles show any relationship between physical activity level and body mass index.

FIGURE 20
Link between body mass index quintile and level of physical activity defined by energy expenditure (kcal/kg/day), Age 15–24



In the above discussion, the relationship between physical activity level and body mass index can only be seen in the first quintile of the general population. For the second to fifth quintiles, where no such relationship is apparent, the sum of skinfolds is definitely higher with lower activity levels (Figure 21). This merits special attention, particularly where women are concerned, because they are more likely to show excessive skinfolds.

FIGURE 21
Link between sum of skinfolds quintile and level of physical activity defined by energy expenditure (kcal/kg/day), Age 10+



That body mass index would not change where sum of skinfolds does is in line with research showing that exercise sometimes improves body composition without showing any effect on body weight.[4] This effect is brought about by a redistribution of muscle and fat: although fat mass decreases, muscle mass increases. Muscle mass weighing more than fat mass, body weight stays the same. Nonetheless, the individual notices the difference, since the toning effect may cause clothes to fit better, etc.

Overall, being physically active is accompanied by higher cardiovascular endurance, higher muscular endurance, and lower levels of body fat. Grip strength is generally unaffected by energy expenditure, as is flexibility, though the data suggest

that an investigation of the role of physical activity in preventing the *decrease* of flexibility with age is warranted.

2. Relationship Between Fitness and Physical Activity Change

By virtue of its longitudinal nature, the 1988 Campbell Survey on Well-Being in Canada enables us to see individual change in physical activity patterns over the seven-year period separating the 1981 Canada Fitness Survey and the 1988 survey. An overview of the main results, published in 1990,[5] reported that approximately 25% of Canadians adhered to physical activity, either by maintaining their level (high or moderate) or making slight gains or reductions (going from moderate to high or from high to moderate). Another 25% started being active, moving from sedentary to either moderately or highly active, and 14% discontinued any physical activity they had been engaging in seven years earlier. The remaining segment, which is the single largest segment of the population (32%), consisted of people who were inactive in both surveys.

These classifications, which represent a measure of change in physical activity, can be assessed against the 1988 fitness levels of Canadians. Since health conditions such as hypertension are more prevalent among older age groups, the analysis is restricted to Canadians aged 45 and older. The following figures show the relationship between change in physical activity and various fitness parameters.

Figure 22 shows the relationship between change in physical activity and VO_2 max. In the first four quintiles, people who maintained their activity level seem to have a slightly, but significantly, better VO_2 max than those who just started or resisted activity altogether. No such relationship is found for people in the fifth quintile—those may include Canadians with a high natural level of cardiovascular endurance.

FIGURE 22
Relationship between VO_2 max quintile and activity change between 1981 and 1988, Age 45+

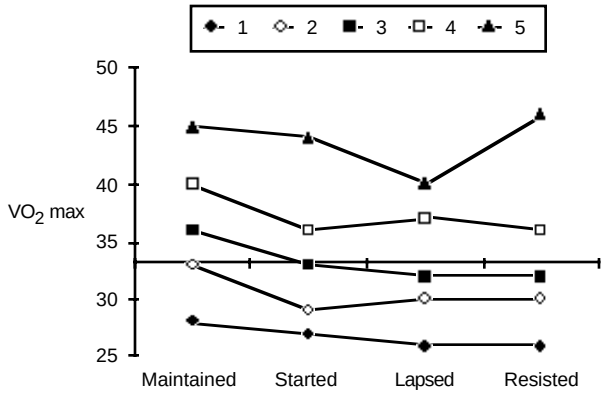


Figure 23 shows the link between change in physical activity and another aspect of fitness: flexibility. In the third and fourth quintiles, flexibility is slightly better for people who maintained their activity pattern than for those who resisted activity. These differences were not significant, however.

FIGURE 23
Relationship between flexibility quintile and activity change between 1981 and 1988, Age 45+

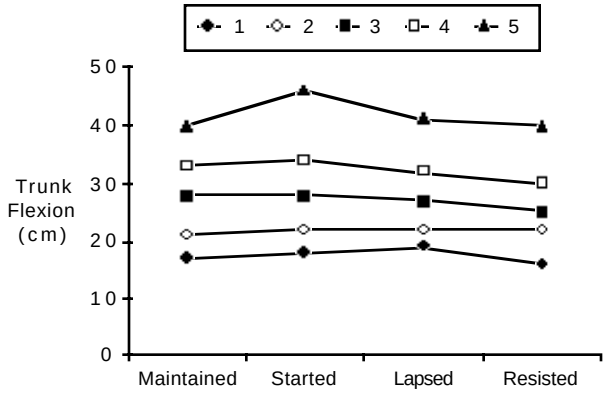


Figure 24, which looks at strength, indicates that in the third and fourth quintiles, there is a significant increase in grip strength between non involvement in physical activity and high adherence.

FIGURE 24
Relationship between strength quintile and activity change between 1981 and 1988, Age 45+

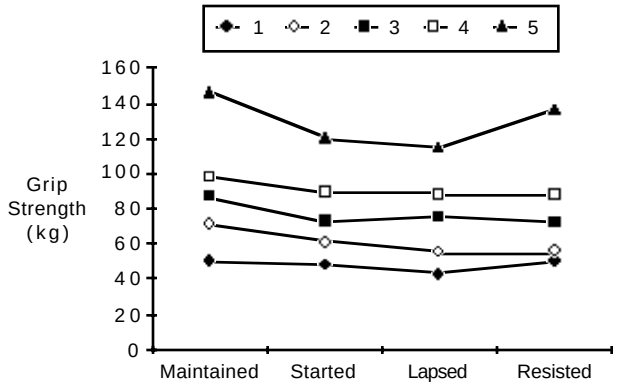


Figure 25 shows that overall, stronger adherence patterns are accompanied with significantly higher muscular endurance levels, as determined by the number of push-ups performed. Figure 26, which focuses on sit-ups, shows a similar pattern.

FIGURE 25
Relationship between muscular endurance (push-ups) quintile and activity change between 1981 and 1988, Age 45+

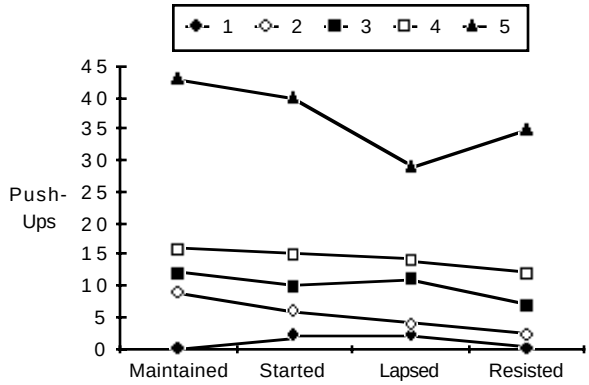


FIGURE 26
Relationship between muscular endurance (sit-ups) quintile and activity change between 1981 and 1988, Age 45+

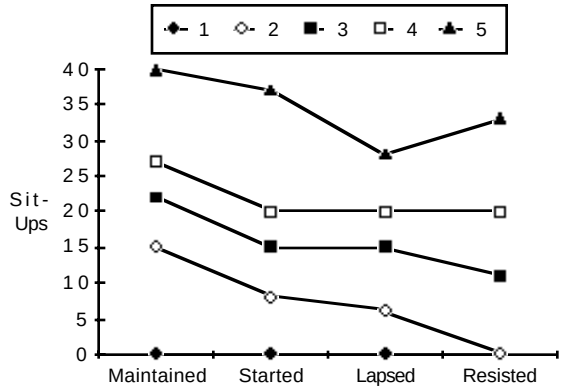


Figure 27 shows that regardless of activity pattern, body mass index remains the same, except in the most obese quintile (quintile 1), where those who resisted physical activity between 1981 and 1988 are significantly more overweight than others who maintained their participation in physical activity. Those who have started physical activity have the same profile as those who resisted. With maintenance, will they display the same reductions in body mass index scores? These reductions have important implications for the cardiorespiratory risk profile of this overweight group.

FIGURE 27
Relationship between body mass index quintile and activity change between 1981 and 1988, Age 45+

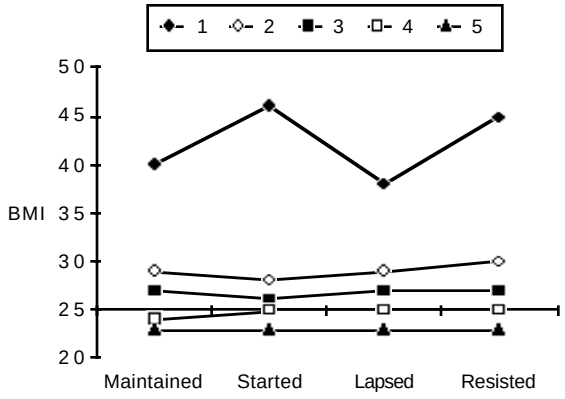
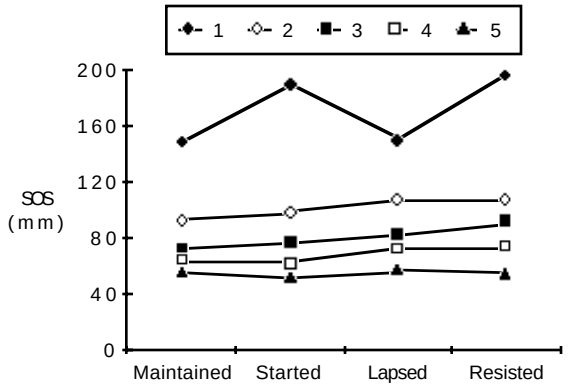


Figure 28 adds information about the amount of excess fat among people who are more involved in physical activity. People who maintained their physical activity levels between 1981 and 1988 are more likely to have significantly lower sums of skinfolds than people who resisted an active lifestyle. This applies to all quintiles except, not surprisingly, the leanest quintile.

FIGURE 28
Relationship between sum of skinfolds quintile and activity change between 1981 and 1988, Age 45+



III. IMPACT OF ACTIVITY PATTERNS ON THE HEALTH CARE SYSTEM

1. Individual Risk Associated with Current Fitness Levels

In their 1989 article, Blair and colleagues reported that men in the least fit quintile had 3.44 times as much risk of dying prematurely as men in the most fit quintile. For women in the least fit quintile, the risk was even greater: they incurred 4.65 times as much risk as women in the most fit quintile. Applying these values to the Canadian population represented in the 1988 Campbell Survey on Well-Being in Canada, we estimate that 20% of the "asymptomatic" population runs a similar risk. This represents 1.28 million men and 1.31 million women in Canada.

The distinction is made between the asymptomatic and the symptomatic samples of the 1988 survey, since the asymptomatic sample most closely reflects the make-up of Blair et al.'s sample. An asymptomatic population would not show symptoms of serious health conditions while the symptomatic population would. The American sample consisted of patients who, at baseline, "had no personal history of heart attack, hypertension, stroke, or diabetes; no resting electrocardiographic (ECG) abnormalities; and no abnormal responses on the exercise ECG."

In the 1988 Canadian survey, the sample that performed the fitness tests consisted of people who were not screened out by the PAR-Q. Respondents who were "screened in" did not report heart trouble, frequent pain in the heart and chest, spells of severe dizziness, blood pressure medication prescribed by the doctor, bone or joint problem, or other serious health condition. Approximately 72% of the sample was not screened out of the fitness tests by the PAR-Q and are referred to as the asymptomatic population. Since this percentage decreases to 49% of respondents aged 45 and older, the actual proportion of Canadians at risk as a result of low fitness may well be significantly higher than 20% if we included the symptomatic population as well.

2. Public Health Risk Associated with Current Fitness Levels

Determining the overall public health risk due to lack of fitness may be done by assessing several health attributes studied in the 1988 Campbell Survey on Well-Being in Canada against the health risk associated with fitness level. Blair et al.'s fitness levels can be used to classify people according to cardiovascular endurance fitness. On one end of the scale, the optimal fitness standards are 35 $mL \cdot kg^{-1} \cdot min^{-1}$ for men and 31.5 $mL \cdot kg^{-1} \cdot min^{-1}$ for women. At the other end of the scale, individuals face high health risk; their VO_2 max level is estimated at 21 $mL \cdot kg^{-1} \cdot min^{-1}$ or below. In between, individuals can be categorized as incurring an elevated health risk.

The following tables have been set up with these categories in mind, classifying the asymptomatic population (that did not show symptoms of serious health conditions and therefore took part in the fitness tests) under optimal health, elevated health risk, and high health risk. Comparisons with the symptomatic population can be drawn, though no cardiovascular endurance information is available for this group.

Table 2 shows a list of restrictions to daily activities, with percentages of people who reported these restrictions within the various risk categories. Startling differences are observed between the optimal fitness group and the high health risk group with respect to ability to climb stairs. Indeed, optimally fit people are eight times less likely to experience the restriction than people at high health risk. Compared with people who display optimal fitness, twice as many people with elevated or high health risk have trouble standing. Difficulty in bending down to pick up objects is also reported more frequently with lower levels of fitness, as is bending to cut toenails. Even walking 400 metres is reported four times more frequently by people with high health risk than by people with optimal fitness. Similar results hold for people over 45 years of age.

TABLE 2
Restrictions in daily activities by health risk associated with fitness level

Restriction	Asymptomatic			Symptomatic
	Optimal fitness[1]	Elevated health risk[2]	High health risk[3]	
Trouble walking 400 metres	2	3	8	8
Trouble climbing stairs	3	5	23	19
Trouble moving around room	1	1	_	1
Trouble standing	8	14	16	20
Trouble bending down	3	9	12	19
Trouble dressing	1	3	3	4
Trouble getting in/out of bed	2	2	3	4
Trouble cutting toenails	2	5	15	10
Trouble grasping	1	2	4	6
Trouble reaching	1	2	4	6
Trouble cutting food	1	1	_	3

1 VO_2 max ≥35 for men; ≥31.5 for women.

2 VO_2 max between 21.1 and 34.9 for men; between 21.1 and 31.4 for women.

3 VO_2 max ≤21 for both men and women.

Such limitations have significant consequences on the autonomy of Canadians. Clearly, people who achieve optimal fitness have a greater capacity to be independent than people who have a high health risk as a result of their low level of fitness. It has been stated earlier in this report that older Canadians are most likely not to achieve the fitness standards set by Blair and colleagues. Consequently, a large portion of the older population is at risk of not being autonomous enough to pursue simple activities of daily living.

Table 3 demonstrates how much people within the various health risk groups use the health care system and how well they rate their own health. People in the optimal fitness and the elevated health risk groups are more likely to have paid a visit to their physicians in the year preceding the survey. These visits are presumably for regular annual examinations, since people with optimal fitness are much less likely to have seen their physicians three or more times during that year. Likewise, people who most closely meet the fitness standard are less likely to have spent a night in the

hospital in the year preceding the survey. Similar patterns of health care use hold for people aged 45 and older.

When it comes to rating their health, optimally fit people again seem to have an advantage. Compared with people at high health risk, they are more likely to rate their health as good or very good. They are also less likely to rate their health as only average or as poor or very poor. These results hold for the population aged 45 and older.

TABLE 3
Use of health care services and self-assessment of health by health risk associated with fitness level

	Asymptomatic			Symptomatic
	Optimal fitness[1]	Elevated health risk[2]	High health risk[3]	
1–2 physician visits/last year	44	45	38	33
3+ physician visits/last year	20	27	38	48
1+ hospital nights/last year	7	8	11	12
Self-rated health				
Very good	25	27	16	17
Good	43	46	34	36
Average	29	26	38	40
Poor or very poor	3	<1	12	7

1 VO_2 max ≥35 for men; ≥31.5 for women.

2 VO_2 max between 21.1 and 34.9 for men; between 21.1 and 31.4 for women.

3 VO_2 max ≤21 for both men and women.

The advantages of being optimally fit do not stop here, however. Table 4 shows the relationship between fitness level and smoking behaviour. Optimally fit people are less likely to be current smokers than people at high health risk and are much less likely to have ever smoked.

TABLE 4
Cigarette smoking by health risk associated with fitness level

	Asymptomatic			Symptomatic
	Optimal fitness[1]	Elevated health risk[2]	High health risk[3]	
Current smoker	27	24	38	29
Never smoked	53	39	30	37
Quit 0–7 years ago	11	15	15	14
Quit 8+ years ago	8	22	18	20

1 VO_2 max ≥35 for men; ≥31.5 for women.

2 VO_2 max between 21.1 and 34.9 for men; between 21.1 and 31.4 for women.

3 VO_2 max ≤21 for both men and women.

On the three measures of body composition (Table 5), optimally fit people are less overweight than people with elevated or high health risk. In fact, they are half as likely to have excess weight than people in the next category (elevated health risk), significantly less likely to have excess fat, and three times less likely to have a high waist-to-hip ratio.

TABLE 5
Obesity by health risk associated with fitness level

	Asymptomatic			Symptomatic
	Optimal fitness[1]	Elevated health risk[2]	High health risk[3]	
Body mass index (excess weight)	27	58	49	50
Sum of skinfolds (excess fat)	32	50	55	46
Waist-to-hip ratio (fat distribution)	15	47	44	48

1 VO_2 max ≥35 for men; ≥31.5 for women.

2 VO_2 max between 21.1 and 34.9 for men; between 21.1 and 31.4 for women.

3 VO_2 max ≤21 for both men and women.

Finally, optimally fit people enjoy another significant health benefit: lower levels of hypertension. High blood pressure is most often reflected by high systolic blood pressure. As shown in Table 6, individuals who achieve the optimal fitness standard are four times less likely to be borderline hypertensives than individuals with an elevated health risk. They are five times less likely to be borderline hypertensives than those with a high health risk. The symptomatic population includes both borderline hypertensives and hypertensives.

TABLE 6
Hypertension by health risk associated with fitness level

	Asymptomatic			Symptomatic
	Optimal fitness[1]	Elevated health risk[2]	High health risk[3]	
Diastolic blood pressure ≥90 mmHg, <100 mmHg	6	7	7	13
Systolic blood pressure ≥140 mmHg, <150 mmHg[4]	5	19	26	36

1 VO_2 max ≥35 for men; ≥31.5 for women.

2 VO_2 max between 21.1 and 34.9 for men; between 21.1 and 31.4 for women.

3 VO_2 max ≤21 for both men and women.

4 While borderline hypertension normally includes all systolic pressures between 140 mmHg and 160 mmHg, only the 140-to-150-mmHg range can be examined from the 1988 Campbell Survey on Well-Being in Canada.

Smoking, obesity, and hypertension all increase the risk of premature death and the risk of developing many health problems. Blair et al. estimated that men who smoke run a 2.6 times higher risk than non-smokers and those who have a systolic blood pressure of 140 mmHg or greater run a 1.74 times higher risk than normotensives. In the case of women, those who smoke increase their risk of premature death by 2.69 times, those who have a body mass index of 26.9 or more increase theirs by 1.84 times, and those who have a systolic blood pressure of 140 mmHg or more increase theirs by 3.24 times.

Studies have shown that physical activity is a cost-effective treatment for borderline hypertension, since it is less expensive than medication and equally effective in lowering blood pressure.[6] Furthermore, Blair and colleagues have shown in a recent article[7] that being fit has a protective effect against premature death for hypertensives. Low-fit hypertensive men face a 4.5 times higher risk of premature death than fit hypertensive men. Encouraging hypertensive people to become fit therefore makes economic sense and has a strong potential for reducing the risk of premature death.

Since Canadians who are optimally fit are less likely to smoke, be obese and show borderline hypertension, it may be doubly important to promote the adoption and maintenance of physically active lifestyles to remove these additional risks as well. It could be argued, for instance, that by moving all people who are now at high health risk into the elevated health risk category, there would be fewer smokers, fewer obese people, and fewer hypertensives.

3. A Prevention Strategy for Canada's Health Care System

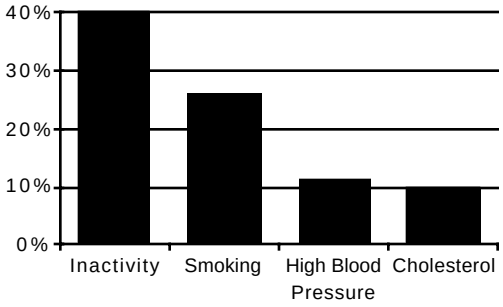
Which of the above risk factors should be tackled first?

In Canada, coronary heart disease is the leading cause of death as well as the largest source of direct and indirect health costs.[8] There are four recognized primary risk factors of coronary heart disease, namely high blood pressure, high blood cholesterol, cigarette smoking, and physical inactivity. The U.S. Centre for Disease Control cites inactivity as the most significant risk factor for coronary heart disease, one that they—and other governments—have the ability to influence and one that has a substantial impact on public health.[9]

Of the four risk factors, sedentary living is the most prevalent one for coronary heart disease in Canada, regardless of how sedentary is defined. One in two Canadians expend less than 1.4 mets of energy daily, a level shown to have an increased risk of all-cause mortality and coronary heart disease.[10] This level is equivalent to less than 490 kilocalories weekly for an individual weighing 50 kilograms and less than 990 kilocalories for a person weighing 100 kilograms.

Figure 29 shows that almost 40% of Canadians are not active on a daily basis. Comparatively, 26% smoke cigarettes regularly[11] and 11% have high blood pressure.[12] About 10% may have high blood cholesterol.[13]

FIGURE 29
Prevalence of important risk factors for coronary heart disease in Canada



The *prevalence* of inactivity as a risk factor is only one component of relative impact on public health. The other component is the *risk of disease* associated with a given risk factor. The prevalence and relative risks associated with key contributors to all-cause death are summarized in Table 7. In the third column, these numbers are converted into their relative impact or risk for the community, which is expressed in terms of the percentage of people potentially affected.

TABLE 7
Relative risk associated with important risk factors of all-cause death in Canada

Risk factor		Prevalence (%)	Relative risk	Community risk (%)
Low versus high fitness quintile[14]	Men	20	3.4	32.4
	Women	20	4.7	42.5
Min. acceptable fitness[15,16] (stopped CAFT before third bout)		33	1.6	16.5
Sedentary (<2000 kcal, equivalent to ≤2.9 mets)[17,18]		69	1.31	17.6
Sedentary (<1000 kcal, equivalent to ≤1.4 mets)[19,20]		45	1.40	15.3
Cigarette smoking[21,22]		26	1.76	16.5
High cholesterol[23,24]	Men	7	2.2	7.7
	Women	9	2.7	13.3
Hypertension (systolic ≥140 mmHg)[25,26]		11	1.73	7.4

The relative risk associated with low physical fitness levels (3.4 for men and 4.7 for women) exceeds that of all the other factors included in the investigations. Blair and colleagues state that a brisk walk of 30 to 60 minutes each day is sufficient to produce the optimal fitness standard. Moreover, because the prevalence of physical inactivity is high (greater than 40%), the relative impact directly attributable to

inactivity for Canadians is high. These calculations illustrate that a physical activity strategy could have greater relative impact on Canadians' health than a smoking cessation strategy or a blood cholesterol reduction strategy.

In the determination of public expenditures, the long-term investment in health promotion and disease prevention strategies is increasingly being weighed against health care costs and potential cost savings. Cost avoidance is a key issue to be balanced against increased quality of life.

Hatziandreu et al. explored the cost-effectiveness of physical activity under several assumptions.[27] Physical activity was found to be cost effective for ischaemic heart disease as long as the cost of individuals' time spent exercising was not included along with direct costs like equipment. This is an appropriate assumption for governments—who do not compensate individuals for such time—and for individuals who enjoy or value physical activity. The analysis resulted in an estimated direct cost of $1,395 (1988 U.S. dollars) per quality-adjusted year of life gained (QALY). Example costs of other coronary heart disease interventions were quoted at $5,000 for bypass graft surgery per QALY and $40,000 per QALY for mild angina. It should be noted that Hatziandreu's analysis included all costs of physical activity but examined only the related costs associated with ischaemic heart disease.

Extra health benefits are also associated with the cost of physical activity, so physical activity is not just cost effective for coronary heart disease. It may be viewed as cost effective in general. Substantial evidence exists that physical activity can increase average life expectancy by as much as two years.[28] Not many interventions have as great an impact. For example, the increase in life expectancy for each woman screened for breast cancer in the United States has been estimated at from 13 to 26 *days*.[29] Some might argue that the added years of life would only be spent in pain and suffering or would result in costly procedures to treat chronic diseases. Fortunately, physical activity also reduces the risk of disease and, in many cases, assists in control and rehabilitation.

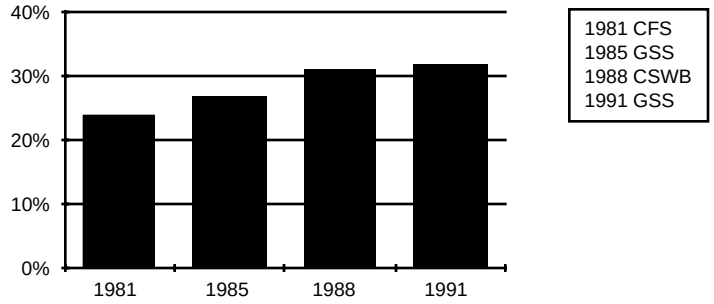
The analysis of Keeler et al.[30] concurs with the cost-effectiveness of physical activity. They calculated discounted lifetime costs like medical care and sick leave and included lost revenues like taxes on earnings. Increasing physical activity was found to "save" an average of $2,570 ($1,900 U.S. dollars) per person.

This argues for attention to physical activity as an important component of Canada's health care system, since the potential savings outweigh the costs at both the individual and the community levels. Being active saves almost twice as much per person as being a non-smoker.[31] Moreover, there are about 1.7 times as many inactive Canadians as there are Canadians who smoke. Granted, there are differences in costs between Canada and the United States. However, even used as a very crude indicator, the potential cost savings are impressive. The lifetime estimate of costs avoided could amount to $24.3 billion for inactive Canadians who became active, compared with $7.7 billion for Canadian smokers who stopped smoking. Most of these costs are typically borne during the last part of people's lives and would be saved at the end of their lives as well.

Physical activity is therefore an effective prevention strategy for the renewal of Canada's health care system, offering the greatest potential for overall cost savings for the government. Can progress truly be made, however? The answer is yes.

The first national survey to examine the prevalence of physical activity based on a definition of health risk was the 1981 Canada Fitness Survey. As shown in Figure 30, 24% of adults were active enough at that time to lower their relative risk based on their typical energy expenditure. (Mortality data shows that a person's energy expenditure is related to his or her risk of all-cause death.) The General Social Survey, conducted in 1985 and 1991, measures energy expenditure using a modified approach but produces results in the same trend as the 1981 Canada Fitness Survey and the 1988 Campbell Survey on Well-Being in Canada. The picture painted by these surveys is clear: the proportion of active Canadians is increasing.

FIGURE 30
Increase in physical activity levels of Canadians between 1981 and 1991, Age 15+



What do these results mean in terms of potential cost avoidance to Canadian governments? During the period from 1981 to 1988, a 7% increase was achieved in the number of Canadians over the age of 15 who were active. This corresponds to an estimated $3.9 billion in costs avoided over the lifetime of these Canadians. From 1988 to 1991, an additional 1% of Canadians became active, resulting in an additional long-term savings of over $540 million.

Canada's physical activity strategy is paying off. A total of $4.4 billion in costs have been avoided as a result of the successful increase in the rate of physical activity over the 10-year period between 1981 and 1991. These avoided costs represent dollars that do not have to be spent from the public purse, freeing the money to be spent in other activities essential to the growth of our economy.

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