Predictors of the decline in physical activity observed in adults from two communities of low socio-economic status in Montreal, Canada

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Abstract

Physical inactivity has been linked to increased rates of coronary heart disease, type 2 diabetes, certain types of cancer, osteoporosis in later life, and poor mental heath and stress management. However, almost two thirds of Canadians are physically inactive. Physical inactivity is more prevalent among Individuals from low socio-economic status (SES) communities who also suffer from higher morbidity and mortality than people from high SES areas. Hence, physical inactivity presents an important target for intervention programs in communities of low SES. Few studies have documented longitudinal predictors of changes in physical activity rates, particularly in low SES communities. This study assessed the predictors of the decline in physical activity levels observed over the course of a 5 year longitudinal cohort of adults aged 18-65 living in two low-income, inner-city neighbourhoods in Montreal. The current study made use of data collected as part of Cœur en Santé St. Henri, an intervention program designed to decrease cardiovascular disease (CVD) risk factors. A two-stage cluster telephone survey of a representative sample of residents was used to collect information on a variety of lifestyle behaviours. Multiple logistic regression was used to assess the independent predictors of decline in leisure time physical activity in 626 subjects. Significant predictors of the decrease in physical activity include age (OR=1.0 (1.0, 1.1) and BMI (OR=2.0 (1.1, 3.6), and a composite index assessing self-efficacy pertaining to physical activity (OR=2.0 (1.2, 3.2), in males. In females, significant predictors include lack of energy (OR=2.4 (1.2, 4.6), perceived lack of athletic ability (OR=2.4 (1.1, 5.2), not using a neighbourhood facility for physical

activity (OR=2.8 (1.6, 4.7), BMI (OR=2.1 (1.2, 3.7), and a composite index assessing self-efficacy pertaining to physical activity (OR=2.1 (1.3, 3.5). Therefore, factors such as BMI, self-efficacy, and the environment all influence physical activity behaviour over time, and as such, should inform prevention programs.

Résumé

L'inactivité physique est associée à une augmentation du taux de plusieurs maladies, tel que les maladies coronariennes, le diabète de type 2, certains cancers, l'ostéoporose, ainsi qu'à des problèmes de santé mentale et de gestion du stress. Néanmoins, presque deux tiers des Canadiens sont physiquement inactifs. Le faible statut socio-économique (SES) a aussi été lié à la fois à l'inactivité physique et à des taux de mortalité et de morbidité élevés. L'inactivité physique représente donc une cible importante pour des programmes d'intervention pour les communautés de faible niveau socio-économique. Peu d'études ont documenté les déterminants longitudinaux de la pratique d'activité physique, et ce, particulièrement dans les communautés de statut socio-économique faible. Cette étude a évalué les déterminants du déclin des niveaux d'activité physique observés au cours d'une période de cinq années sur une cohorte longitudinale d'individus âgés de 18 à 65 ans et vivant dans deux voisinages à faible-revenu de Montréal. La présente étude a fait usage des données recueillies lors du programme Coeur en Santé St. Henri, programme communautaire de prévention cardio-vasculaire. Afin de recueillir des renseignements sur une variété d'habitudes de vie, nous avons utilisé les résultats de deux d'enquêtes téléphoniques de sondage auprès d'un échantillonage représentatif des résidents de St. Henri et du Centre Sud. Une régression logistique multiple a été utilisée afin d'évaluer les déterminants indépendants du déclin de l'activité physique de loisir parmi 626 sujets. Les déterminants significatifs de la diminution de l'activité physique chez les hommes

incluent l'âge (RC = 1.0 (1.0, 1.1) et IMC (RC = 2.0 (1.1, 3.6), et un index composite évaluant la connaissance de ses propres capacités en rapport avec l'activité physique (RC = 2.0 (1.2, 3.2). Chez les femmes, les déterminants significatifs incluent un manque d'énergie (RC = 2.4 (1.2, 4.6), un manque d'habileté athlétique (RC = 2.4 (1.1, 5.2), la non-utilisation d'une centre d'activité sportive du voisinage dans le but de participer à une activité physique quelconque (RC = 2.8 (1.6, 4.7), IMC (RC = 2.1 (1.2, 3.7), et un index composite évaluant la connaissance de ses propres capacités en rapport avec l'activité physique (RC = 2.1 (1.3, 3.5). Des facteurs, tels que l'IMC, la connaissance de ses propres capacités ainsi que l'environnement, ont tous une influence dans le temps sur le comportement individuel par rapport à l'activité physique, et en tant que tels, devraient influencer les programmes de prévention.

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Contribution of Authors

The candidate conducted all the analyses, as well as the initial interpretation of results and manuscript preparation. The candidate worked closely with the thesis supervisor, Dr. Gilles Paradis, in the development of the research question. Dr. Paradis, and the other members of the thesis advisory committee, Dr. Jennifer O'Loughlin and Dr. Robert Platt, provided guidance regarding the selection of study variables, the choice of analysis methodology, the interpretation of study results, as well as reviewing the manuscript. The manuscript, *Predictors of the decline in physical activity observed in adults from communities of low socio-economic status in Montreal, Canada*, was co-authored by the members of the thesis advisory committee.

Abbreviations

SES= socio-economic status

CVD= Cardiovascular disease

BMI= Body Mass Index

PA= Physical activity

LTPA= Leisure-time physical activity

ACSM= American College of Sports Medicine

SEF= Self-efficacy

SS= Social support

TRA= Theory of reasoned action

TPB= Theory of planned behaviour

SLT= Social learning theory

SCT= Social cognitive theory

OR= Odds ratio

CI= Confidence interval

SD= Standard deviation

RRR=Ratio of the relative risk

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1. Introduction

Although it has been known for some time that physical activity can protect against a host of health problems, almost two thirds of Canadians are physically inactive. Inactivity has been linked to increased rates of coronary heart disease, type 2 diabetes, certain types of cancer, as well as osteoporosis in later life. In addition, physical activity has been linked to better mental health and positive stress management practices (US Department of Health and Human Services 1996, Sallis and Owen 1999). Given the evidence of the benefits of physical activity, decreasing the prevalence of physical inactivity has become an important public health goal. In Canada, the prevalence of physical inactivity in the adult population has been estimated at 62% (Health Canada 1999). One estimate indicates that inactivity can be linked to 21, 340 premature deaths each year, and costs the health care system $2.1 billion annually, or 2.5% of the total direct health care costs in Canada in 1999 (Katzmaryzk et al. 2000). If the prevalence of physical inactivity could be reduced by 10%, an estimated annual savings of $150 million could potentially be achieved (Katzmaryzk et al. 2000). According to a recent report released by the Surgeon General in the U.S., 60% of American adults are not sufficiently active to achieve health benefits from physical activity, and 25% are not active at all (U.S. Department of Health and Human Services 1996).

Many studies have identified risk factors associated with physical inactivity. Subsequently, intervention programs were designed to increase physical activity, at both the individual and the community level. While individual

interventions have had some success, interventions implemented at the community level have had only marginal levels of success (Sallis and Owen 1999). It has become clear that the issues surrounding adoption and maintenance of physical activity are influenced by a complex set of personal and environmental factors. A better understanding of the factors associated with a physically active lifestyle, and conversely those associated with inactivity may help future programs to achieve greater levels of success. In the future, successful intervention programs might help decrease the morbidity and mortality associated with physical inactivity.

One of the factors that has emerged as an important predictor of physical activity is socio-economic status (SES). Studies have repeatedly indicated that low SES individuals have increased morbidity and mortality, as well as increased rates of physical inactivity (Winkelby et al. 1998, Winkelby et al. 1999, Winkelby et al. 2003, Yen et al. 1998, Yen et al. 1999, Luepker et al 1993). However, few studies have attempted to identify risk factors associated with physical inactivity in low SES communities.

The purpose of the current study is to identify risk factors associated with the declining prevalence of physical activity observed in two low SES neighbourhoods in Montreal, Canada.

2. Review of the Literature

The following section will discuss the relevant literature with regards to the study of physical activity. Included in this section are definitions and recommended levels of physical activity, and a discussion of some of the theories that are used to study health behaviours. The section concludes with a review of studies that have examined correlates and risk factors associated with a physically inactive lifestyle.

2.1 Physical activity, exercise and physical fitness

Casperson et al (1985) formulated the definition of physical activity that has gained the widest acceptance, as "any bodily movement produced by skeletal muscle that results in energy expenditure". This is typically expressed in terms of kilocalories expended per unit time, during work or leisure. Physical activity can be further subdivided with respect to the type of muscle contraction that is occurring, or based on the metabolic expenditure of the muscles during the contraction. Physical activity of a group of people is often subdivided based on the type of activity, such as leisure, household or occupational activities. Exercise, on the other hand, is often considered a subset of physical activity. It represents an activity performed in a planned and structured manner, often with the goal of improving or maintaining health and fitness (Casperson et al. 1985). The definition of physical fitness is somewhat more complex. One accepted approach is to define physical fitness as "the ability to carry out daily tasks with

vigor and alertness, without undue fatigue, and with ample energy to enjoy leisure-time pursuits and to meet unforeseen emergencies." (U.S. Department of Health and Human Services, 1996). According to this definition, physical fitness thus includes cardiorespiratory endurance, skeletal muscular endurance, skeletal muscular strength, skeletal muscular power, speed, flexibility, agility, balance, reaction time and body composition.

2.2 Measurement of physical activity

The measurement of physical activity, physical fitness and exercise is a complex issue. There are two broad categories into which measurement techniques can be divided. The first includes self-report measures, while the second includes those measures that involve the use of direct observation of the study subjects, including activity and heart rate monitoring (US Department of Health and Human Services, 1996, Sallis and Owen 1999). Physical activity is most often assessed in epidemiological studies using self-report measures. Some of the methods included in this category are diaries, logs and recall surveys. Diaries and logs are similar, in that in both cases, the subject is asked to chronicle his participation in activities. The main difference is that a diary would include all activities, while a log would include only one activity. Thus, logs are generally more useful for recording participation in an exercise training program, and diaries are more useful for chronicling physical activity in general. Both are generally used only for short-term recording, often less than one week. As well,

diaries and logs require a substantial amount of involvement from the participant, and thus may not be well received by study subjects. It is also possible that the act of chronicling physical activity will influence the behaviour itself (US Department of Health and Human Services, 1996). Recall surveys are less likely to influence activity behaviour and generally require less effort by the subject. Recall surveys for physical activity have been used for time frames ranging from one week to a lifetime. However, the longer the recall period, the more likely recall bias will be introduced. These surveys can be self-administered, or they can be administered over the telephone or in person using trained interviewers. Respondents can be asked to recall a variety of physical activities, including those engaged in during leisure time, through the completion of household tasks, and at work. Questions can range from the very general to the very specific. For example, respondents can be asked to report the frequency of their participation in activities that cause sweating or breathlessness. Or respondents can be asked to report the frequency, intensity and duration of the activities in which they participate (Sallis and Owen 1999, US Department of Health and Human Services 1996, Kriska et al. 1999). The two most common estimates which are obtained from questionnaire data are derived from summing either time spent in physical activity, or time weighted by an estimate of the intensity of that activity. Multiplying the frequency of sessions by the duration of each session derives time. It is then possible to obtain a summary measure of energy expenditure by multiplying the average hours per week of reported activity by a measure of average intensity, such as metabolic cost, which takes into account the caloric

expenditure required for activity (Kriska et al. 1997). Questionnaires that employ this methodology (Taylor et al. 1978, Kohl et al. 1988, Paffenbarger 1978) generally require a somewhat detailed analysis of exercise habits, and therefore ask study participants to indicate the frequency and duration of specific activities. The pre-determined intensities of each activity are then used in the calculation of energy expenditure. Alternately, some survey tools assess only frequency of activity, by asking questions such as; "Considering a 7-day period, how many times on average do you engage in vigorous exercise (in which your heart beats rapidly) for more than 15 minutes, such as running, jogging, cross country skiing, judo, roller skating, vigorous swimming, vigorous long distance bicycling?" (Godin and Sheppard 1985). Similar questions are included to assess frequency of moderate and mild intensity exercise, and these are combined into a measure that indicates total weekly physical activity.

While recall surveys are clearly easier to administer to large groups, and require less effort on the part of study participants, their utility depends largely on their validity, or accuracy, and reliability, or repeatability. Factors that can interfere with obtaining an accurate physical activity assessment include incomplete or inaccurate recall and exaggeration of physical activity participation. For example, when using self-report measures, a certain degree of error will be introduced by participants' ability to recall their physical activity behaviour. As well, self-report measures are subject to error introduced by participants' desires to yield socially desirable responses. For instance, the widespread knowledge of

the benefits of physical activity may entice subjects to over report their activity in order to yield "desirable" responses.

One of the key difficulties in assessing validity of any measure of physical activity is the lack of a "gold standard" criterion for use as comparison. In the absence of a true measure for comparison, cardiorespiratory fitness is often used as a surrogate. A perfect correlation would not be expected, because cardiorespiratory fitness can be influenced by a variety of other factors, including genetics. Nevertheless, several studies have used this measure as the standard. Results from studies comparing self-report instruments to cardiorespiratory fitness are presented in Table 1 (US Department of Health and Human Services 1996). Studies have also been conducted using other measures as the standard, yielding similar results. While such studies often produce significant correlation coefficients, the values are not high, indicating that even the best self-report measures have considerable error.

Table 1- Correlation of two different survey instruments; the Minnesota Leisure-Time Physical Activity Questionnaire and the College Alumni Survey, with several physiologic measures of caloric exchange (USDHHS 1996)			
Study	Sample	Physiologic test	Correlation coefficient
Minnesota Leisure-Time Physical Activity Questionnaire			
Taylor et al.(1978)	175 men	Treadmill endurance	0.45
Skinner et al.(1966)	54 men	Submaximal treadmill test	0.13*
Leon et al.(1981	175 men	Treadmill Submaximal heart rate	0.41 0.59
DeBacker et al.(1981)	1513 men	Submaximal treadmill test	0.10
Jacobs et al.(1993)	64 men and women	VO_2 max Submaximal heart rate	0.43 0.45
Richardson et al.(1995)	78 men and women	VO_2 max	0.47
Albanes et al.(1990)	21 men	Resting caloric intake	0.17*
Montoye et al.(1996)	28 men	Doubly labelled water	0.26*
College Alumni Survey			
Siconolfi et al.(1985)	36 men 32 women	VO_2 max	0.29 (Men) 0.46 (Women)
Jacobs et al.(1993)	64 men and women	VO_2 max Submaximal heart rate	0.52 0.52
Albanes et al.(1990)	21 men	Resting caloric intake	0.32*
Montoye et al.(1996)	28 men	Doubly labelled water Energy intake (7 days)	0.39 0.44

*Non significant correlation coefficient

Several studies have been conducted in order to assess the reliability of self-report measures. The measure developed by Godin and Sheppard (1985) yielded test re-test reliabilities of 0.94, 0.46, and 0.48 for vigorous, moderate and light activity, respectively, and 0.74 for total activity (Sallis and Owen 1999, Kriska et al. 1997). Other studies have yielded similar results and have suggested that strenuous or vigorous activity yield higher reliability than light or moderate activity

(Sallis and Owen 1999). One problem with conducting this type of assessment is that many respondents will engage in no activity at either interview, thus inflating the reliability. As well, physical activity behaviour can be quite variable with time, so that questionnaires with a short recall period may yield low reliability due to actual variation in the behaviour, a poor instrument, or both.

The predominant alternative to self-report measures is to use measures based on direct monitoring. Such measures generally involve the measurement of physical activity through behavioural observation, mechanical or electronic devices, or physiologic measurements. These approaches eliminate many of the problems that can be encountered when self-report is used, such as incomplete recall. However, the utility of these measures, which include direct observation of study subjects, heart rate monitoring, pedometers, direct and indirect calorimetry and the use of doubly labelled water, is limited by their cost, and the degree to which study subjects are inconvenienced (USDHHS 1996, Sallis and Owen 1999).

The section that follows discusses the current recommendations pertaining to physical activity levels, and includes an historical overview of the development of these recommendations.

2.3 Recommended levels of physical activity

In 1978, the American College of Sports Medicine (ACSM) developed the first recommendations regarding the amount of physical activity required by healthy adults in order to improve aerobic fitness and body composition (Sallis and Owen 1999). Entitled "The Recommended Quantity and Quality of Exercise for Developing and Maintaining Fitness in Adults", the document included the following guidelines;

- Frequency of training – 3 to 5 days per week
- Intensity of training – 60% to 90% of maximum heart rate reserve, or 50% to 85% of maximum oxygen uptake
- Duration of training – 15 to 60 minutes per session
- Activity type – aerobic or rhythmic use of large muscle groups in activities such as running or jogging, walking, swimming, cycling, cross-country skiing, rope jumping and various endurance games and sports.

Because these were the first quantitative guidelines produced on this subject, they were adopted as the standard in many parts of the world. While an important first step, however, they contained several flaws. First, these guidelines were developed based on how much activity is needed to promote aerobic fitness in sedentary adults, but were quickly interpreted to indicate what was required for good health. Second, many of the studies that were used in the development of the guidelines used Caucasian males as study subjects. Third, the aerobic activity outlined in the guidelines was not appealing to the vast majority of

sedentary adults, and thus were ignored by a significant portion of the adult population (Sallis and Owen 1999).

Since 1978, a substantial amount of research has demonstrated that different amounts and intensities of activity confer health benefits. For example, several studies have shown that moderate levels of activity lead to a significant decrease in all cause mortality (Sallis and Owen 1999, US Department of Health and Human Services 1996). As well, the greatest health benefits are seen between the lowest and intermediate levels of physical activity. There is substantially less protection conferred between the intermediate and highest levels of activity (Sallis and Owen 1999, US Department of Health and Human Services 1996). Recommendations around the world, employing the current ACSM guidelines, have now been modified to include moderate activity. The current ACSM guidelines are as follows;

- With regards to vigorous activity, the recommendations remain largely unchanged from the 1978 guidelines. Small changes include a reduction from 60% to 50% of maximal heart rate. Also, the minimum duration of each session was increased from 15 to 20 minutes.
- Guidelines were added regarding resistance training, recommending one set of 8-12 repetitions of 8-10 different exercises, at least 2 days per week.
- The biggest change included the addition of guidelines regarding moderate intensity activity, stating that every US adult should accumulate 30 min. or more of moderate intensity physical activity on most, preferably all, days of the week (this could include multiple sessions of short duration).

Although the benefits of moderate activity are now widely accepted, the ACSM maintains that increasing intensity and/or duration of activities will confer greater health and fitness benefits, and thus those who are able, are recommended to undertake activities of increased duration and intensity (Sallis and Owen 1999, US Department of Health and Human Services 1996).

According to Health Canada's Physical Activity Guide to Healthy Active Living, the most recent governmental recommendations on physical activity in Canada, an hour of low intensity activity is required daily, or 30-60 minutes of moderate activity or 20-30 minutes of vigorous activity, 4-7 times a week (Health Canada). This guide divides physical activity into three groups; endurance (4-7 days per week), flexibility (4-7 days per week), and strength (2-4 days per week). These guidelines also recommend commencing with light activities, divided into smaller sessions as required, then progressing to shorter sessions of moderate or vigorous activities, which can be undertaken fewer days per week.

An important challenge for public health is to transform recommendations for increasing physical activity into programs that produce sustainable changes in individual behaviour. To produce such effects program planners and professionals need to understand how human behaviours and in particular physical activity behaviours are adopted and maintained. Many theories have been developed over the past several decades to explain health-related behaviours. The next section discusses some of the theories that have been developed in order to explain physical activity behaviours.

2.4 Relevant theories regarding healthy behaviour

Many models and theories have been designed, each with the goal of explaining health behaviour and each with its staunch advocates and detractors. One review of 116 theory based articles published between 1986 and 1988 found 51 distinct theoretical formulations (Glanz et al. 1997). Thus, the review included in this document is not intended to be comprehensive, rather it is included to familiarize the reader with some of the predominant theories in the field.

A theory can be defined as "a set of interrelated propositions containing concepts that describe, explain, predict or control behaviour."(Glanz et al, 1997). With regards to health education and promotion, no single theory dominates. Health behaviour is far too complex to be fully explained by any one theory. As well, different theories are better suited to different settings. One theory may be most appropriate in a clinical setting, where a physician is counselling a patient. Another theory may be better suited to an intervention carried out at the community level. Thus, many theories have been constructed, each with its own strengths and limitations. Several of the more commonly employed theories are discussed below.

2.4.1 Health Belief Model

This model was first designed in the 1950's, by a group of social psychologists at the U.S. Public Health Service. They were attempting to explain the widespread

failure of people to participate in programs to detect or prevent disease, namely tuberculosis (Glanz et al. 1997). The model was later extended, and applied to a person's response to symptoms and diagnosis of illness, as well as to compliance with medical regimens (Glanz et al. 1997). The model stems from two concepts, which when taken together, where found to influence the choice of a healthy lifestyle. The first is the desire to avoid illness, or to get well. The second is the belief that a particular course of action will prevent illness or return a person to a healthy condition. These two concepts were further subdivided with respect to the individual's estimation of personal susceptibility to and severity of an illness or condition, as well as the likelihood of being able to reduce that threat through action (Glanz et al. 1997). Briefly, the components of the model are as follows:

- Perceived susceptibility; refers to an individual's subjective perception of the risk of contracting a particular health condition
- Perceived severity; refers to an individual's feelings regarding the potential consequences if the disease is contracted. These can include both physical consequences, such as pain, disability and death, as well as social consequences, such as effects on work and family life. Some investigators have found it useful to combine perceived susceptibility and severity into one term, perceived threat (Glanz et al. 1997)
- Perceived benefits; refers to the beliefs an individual has regarding the effectiveness of the various available actions in reducing the treat of disease, or the perceived health benefits of a particular action.

- Perceived barriers; the potential drawbacks to a particular course of action.

These may act as impediments to the undertaking of a particular behaviour. Investigators now contend that there are additional variables that are important with regards to this model. Socio-demographic factors, such as education, income, age, and sex, are believed to influence an individual's perceptions of threat, benefit, and barriers. As well, some researchers believe that self-efficacy should be included in the model. This concept was introduced by Bandura in 1977, and will be discussed later.

One criticism of this model is that it focuses almost entirely on the individual, and neglects the influence that environmental or societal factors might exert. It is very reasonable to envision a situation where an individual would choose a healthful lifestyle, but is unable to execute this choice, due to factors beyond his or her control.

2.4.2 Theory of Reasoned Action/ Theory of Planned Behaviour

These theories "focus on theoretical constructs concerned with individual motivational factors as determinants of the likelihood of performing a specific behaviour." (Glanz et al.1997). The Theory of Reasoned Action (TRA) was developed first, and has been extensively validated, while the Theory of Planned Behaviour (TPB) is newer, and thus has not been as well validated. The TRA was first introduced in 1967 and is concerned with the relationship between beliefs, attitudes, intentions and behaviour. It was developed in an attempt to understand

the relationship that exists between attitudes and behaviour. This theory asserts that the most important determinant of behaviour is a person's behavioural intention. Behavioural intention is directly determined by two factors; the person's attitude towards performing the behaviour, and his subjective norm with regards to the behaviour (Glanz et al. 1997). Attitude is in turn influenced by two factors; behavioural beliefs and evaluation of behavioural outcome. In other words, a person's attitude toward a particular behaviour is determined by that person's beliefs regarding the outcome of the behaviour, weighted by evaluations of those outcomes. Subjective norm is also influenced by two factors; normative beliefs and motivation to comply. Normative beliefs refer to the influence important referent individuals may exert on the individual, for example the influence of health care providers and family members. Thus, the subjective norm is determined by whether or not important referent individuals approve or disapprove of a particular behaviour, weighted by the likelihood that the individual will comply with the referent individual. This model builds a framework for identifying key behavioural and normative beliefs that affect behaviour. In theory, interventions could then be designed to target a person's attitude toward a particular behaviour, or the subjective norm, in order to elicit a change in behaviour. The TRA has been used to explain a variety of health behaviours, including smoking, drinking, contraceptive use, clinical breast exam, mammography, exercise, seat belt use and safety helmet use (Glanz et al. 1997). One weakness of this theory, however, is that it can be used to explain behavioural intention, regardless of whether or not the behaviour is under the

volitional control of the subject. Thus, the degree to which the theory is successful in explaining actual behaviour is determined by the degree of volitional control the subject exerts over the behaviour. A subsequent theory, the Theory of Planned Behaviour (TPB) was therefore developed, in order to predict behaviours over which people have incomplete volitional control. To account for this, a third determinant was added to the TRA, that of perceived behavioural control. This factor is said to act on both the behavioural intention and the behaviour itself. Perceived behavioural control is influenced by two factors; control beliefs and perceived power. Control beliefs refer to a person's ideas regarding the presence or absence of resources for and impediments to behavioural performance. Perceived power refers to the impact of each resource to facilitate or inhibit the behaviour in question (Glanz et al. 1997). While this model has not as of yet been widely applied to exercise behaviour, it has been used successfully for other health behaviours, such as the prediction of mammography and condom use (Glanz et al. 1997).

2.4.3 Social Learning Theory

Social Learning Theory (SLT) includes some of the behavioural and personal elements seen in the previous models, and incorporates environmental factors as well. Miller and Dollard introduced SLT in 1941, in order to explain imitation behaviour observed in animals and humans. In 1962, Bandura continued the research in this field, and became its leading figure. Briefly, Bandura proposed

that children learn by watching other children, and thus do not need to experience a reward themselves. Rather they can learn the importance of good behaviour by watching other children behave well and be rewarded (Glanz et al.1997). In 1977, Bandura published his first paper that included the concept of self-efficacy, or efficacy expectation (Bandura 1977). Self-efficacy was defined as "the conviction that one can successfully execute the behaviour required to produce the outcomes" (Glanz et al. 1997). In 1978, Bandura proposed the concept of reciprocal determinism, in which environment, person, and behaviour are continually interacting. In 1986 Bandura renamed the theory as Social Cognitive Theory (SCT), with the concept of reciprocal determinism an underlying assumption. The two names are often used interchangeably.

As mentioned, the SCT incorporates three concepts; environmental, behavioural and personal factors. Environmental factors include both the physical and social environments. The physical environment would include climate and proximity to appropriate facilities. The social environment would include family, friends and co-workers, and relates to the concept of social support, as those who constitute the social environment provide social support, whether positive or negative, to the individual in question (Glanz et al.1997). The behavioural factors include behavioural capability, which maintains that in order for a person to undertake a particular behaviour, this person must have knowledge of the behaviour, and the skill to perform it. This concept is an important one, as it distinguishes between learning and performance. A person may be aware of a particular behaviour, but may lack the necessary skills to perform it (Glanz et al.

1997). The personal factors are numerous, and include the expectations one has regarding a particular behaviour, the value a person places on a particular outcome, as well as self-efficacy. The SCT has continued to evolve since its inception in the 1970's, and recent literature on the subject involves the concept of human agency, or the ability to make things happen in one's life (Bandura 2001). In SCT, human agency is subdivided into three categories; personal agency, which includes perceived self-efficacy, proxy agency that relies on others to act on one's behalf, and collective agency, which is exercised through society (Bandura 2001). The behavioural, environmental, and social factors, which were fundamental concepts in earlier incarnations of the SCT, are thus preserved. As well, the concepts of reciprocal determinism and self-efficacy remain pivotal. Internal personal factors and external environmental influences all operate as interacting determinants that influence one another in a bi-directional manner (Bandura 2001). Efficacy beliefs, or the belief in one's ability to exercise some measure of control over one's functioning and environment, remain the foundation of human agency (Bandura 2001). Unless one believes one can generate desired results through one's actions, one has little incentive to act or to persevere in the face of difficulties (Bandura 2001). The SCT has been widely applied to health behaviour research, and the concept of self-efficacy has been found to be predictive of physical activity behaviour (Glanz et al. 1997, Sallis et al 1992 a and b). More detailed descriptions of the SCT are available (Glanz et al. 1997, Bandura 2001, Bandura 1989, Bandura 1977).

2.4.4 Stages of Change Model

James Prochaska and his colleagues developed this concept in the late 1970's. (Laitakari 1998, Samuelson 1997). The model originated from the Transtheoretical Model, which resulted from an analysis of the procedures employed by a variety of psychotherapies with regards to the process of personal change (Laitakari 1998). Later, Prochaska and his colleagues applied the identified processes to health issues such as smoking behaviour. For example, those who were attempting to quit smoking reported that they would employ a particular process at a particular stage of their personal change. These stages were then named, as follows; Precontemplation, Contemplation, Readiness, Action and Maintenance (Prochaska et al. 1982). The processes employed by the individual vary with the stages, in that the initial stages tend to be experiential in nature, while the later stages are behavioural. This model has several advantages. First, it is thought to be cyclical, and can be entered at any one of the stages. Thus, an individual might move forward into Readiness, only to regress to Precontemplation. Additionally, many practitioners feel it is an appropriate model to use in a clinical setting, because stages of change can be easily assessed, and an intervention appropriate to that stage can be designed. However, this model has limitations as well. Some researchers feel that it is too simplistic, that human behaviour cannot be neatly categorised into discrete stages. Bandura wrote that "human functioning is simply too multifaceted and mutlidetermined to be categorised into a few discrete stages" (Bandura 1997).

Bandura also mentions that the stages are merely arbitrary designations along a continuum. The Precontemplators differ from Contemplators only with respect to the degree of their intentions to act (Bandura 1997).

2.4.5 Mandala of Health

This model is a relatively new one, and was promoted by two Canadian researchers, Trevor Hancock and Fran Perkins, though a publication entitled "The Mandala of Health", published in 1985 (Hancock 1985). The term "mandala" refers to "any of various ritualistic geometric designs symbolic of the universe, used in Hinduism and Buddhism as an aide to meditation" (American Heritage Dictionary of the English Language 4th edition, 2000). This model portrays the individual at the centre of a set of environmental factors, each of which will impact to some degree on his choice of a healthy lifestyle. These environmental factors include the family, the community, the human-made environment, culture, and the biosphere (Pederson et al. 1994). As well, the Mandala describes four key factors that influence the individual; human biology, personal behaviour, and the psychosocial and physical environments. Lifestyle is then described as the "personal behaviour as influenced and modified by, and constrained by, a lifelong socialisation process, and by the psycho-social environment, including cultural and community values and standards." (Pederson et al 1994). Although this model is used increasingly in Canada, it has not been used as of yet to predict

levels of physical activity, therefore its use in such a context has not been established.

In order to determine the ability of these models to correlate with and predict changes in physical activity levels, the concepts developed within the models were subsequently included in physical activity research. The following section includes a summary of the correlates and determinants of physical activity behaviour, and includes some of the psychosocial concepts outlined above, as well as demographic variables, such as age, sex and SES, and environmental variables, such as facility access and neighbourhood safety.

2.5 Factors associated with a physically active lifestyle

Studies have found a variety of factors to be associated with a physically active lifestyle. These include demographic factors, such as age, sex, SES and ethnicity, environmental factors such as access to facilities and community safety, as well as psychosocial factors such as the support of friends, family and co-workers.

2.5.1 Sex

The literature indicates a strong association between sex and physical activity. The U.S. Surgeon General's report, which included analysis of data obtained through three different surveys, indicated that males consistently reported significantly lower levels of physical inactivity than females (US Department of Health and Human Services 1996). This trend was apparent in each of the three surveys that were analysed (Table 2).

Table 2- Percentage and 95 percent confidence intervals of physically inactive adults, aged 18+, for data obtained from three surveys, in the U.S. (USDHHS 1996, Chap. 5)

	Survey		
	1991 NHIS*	'88-91 NHANES III**	'92 BRFSS
Male	21.4(20.2, 22.6)	15.8(12.4, 19.2)	26.5 (25.9, 27.1)
Female	26.9(25.8, 28.0)	27.1(23.0, 31.3)	30.7(30.1, 31.3)
Total	24.3(23.2, 25.3)	21.7(19.0, 24.5)	28.7(28.3, 29.1)

*National Health Interview Survey
**Third National Health and Nutrition Examination Survey
***Behavioural Risk Factor Surveillance System

This trend is supported throughout the literature, as researchers have consistently found that men are more active than women (Sallis and Owen, 1999). The Surgeon General's report also indicated that vigorous activity may be more prevalent in men than women, however these results were not conclusive. Only two of the surveys contained data on vigorous activity, and these yielded conflicting results. It appears that not only does sex influence physical activity, but also that it often acts as an effect modifier with regards to other variables. The role of sex as an effect modifier will be discussed with the relevant variables.

2.5.2 Age

Perhaps one of the most consistent findings in the field of physical activity epidemiology is that of the decline in physical activity levels with age (Sallis 2000). Casperson et al. (2000) reported that the prevalence of adolescent leisure time physical inactivity increased from about 6% for male and female respondents aged 14 years, to a peak of approximately 20% at age 20. This study found only one statistically significant difference between the male and female respondents, at age 17. Thus, with regards to physical inactivity, the male and female respondents reported largely the same rates. The percentage of respondents who reported regular, sustained physical activity dropped 16 points and 10 points for males and females respectively, between the ages of 12 and 17 years. The percentages remained essentially stable, at 24% and 20% for males and females, respectively, throughout adulthood. With regards to vigorous activity, the rates began to decline at an earlier age, and declined more sharply than those found for sustained activity. In both cases, initial rates of physical activity were lower for women. However, for sustained activity, the decline was less pronounced, therefore men and women wound up with similar rates at the end of adolescence. For vigorous activity, the women experienced a similar, if not steeper decline, resulting in much lower levels of vigorous physical activity at the end of adolescence.

Table 3- Increase in physical inactivity, and corresponding decrease in physical activity with increase in age through adolescence, in males and females (Casperson et al. 2000).			
Sex	Prevalence of physical inactivity*	Prevalence of sustained, non-vigorous activity**	Prevalence of vigorous physical activity***
Male	6% (age 14)→24% (age 20)	40% (age 12)→24% (age 17)	76% (age 14)→42% (age 21)
Female	6% (age 14)→24% (age 20)	30% (age 12)→20% (age 17)	66% (age 12)→28% (age 20)

*no participation in moderate or vigorous activity
** 5 or more days per week of walking or bicycling, 30 min. or more per occasion.
***3 or more days per week of running, jogging or swimming.

This trend has consistently appeared in studies conducted around the world (Sallis 2000, Sallis and Owen 1999). Thus, it is now widely accepted that the sharpest decline in physical activity prevalence occurs during adolescence, and that sex plays a role in both the initial prevalence of physical activity prior to the decline, and the degree of decline itself.

Throughout adulthood, prevalence of physical activity tends to remain more stable. Casperson et al. (2000) reported that throughout the adult years, women have a prevalence of physical inactivity of 27%, compared to 21% for men. As well, men reported greater levels of sustained physical activity, at 27%, as compared to the women, at 21%.

A report by Health Canada (1999) indicated similar trends in the Canadian population. Prevalence of physical activity in males aged 12 to 14 was 54%, and 31% in males aged 20-24. In females aged 12 to 14, prevalence of physical activity was 33%, and 22% in females aged 20 to 24. The results of this study

also indicated that prevalence of physical activity is largely stable throughout adulthood (Health Canada, 1999)

2.5.3 SES

The literature indicates a clear association between SES and health behaviours, including physical activity. In a study conducted in the UK of 2,690 randomly sampled men and women, SES, defined according to occupation, was found to be associated with weight and weight control practices (Wardle et al. 2001). Women in the lowest SES class were found to be 2.8 times more likely to be obese than women in the highest SES class (95% CI: 1.6, 8.2). With regards to weight control practices, significant associations were reported regarding the perception of self as overweight, weighing at least monthly, attempts to loose weight, restrictive dietary practices and vigorous activity (Table 4).

Table 4- Odds ratios and 95 percent confidence intervals for weight related behaviours and attitudes in relation to socio-economic status (Wardle et al. 2001).

SES class*	Perceived self as overweight	Weigh at least monthly	Try to lose weight	At least three restrictive dietary practices	Vigorous activity for 20 min. at least 3 times/week
1 and 2	(1.00)	(1.00)	(1.00)	(1.00)	(1.00)
3 non-manual	0.90(0.64, 1.28)	1.03(0.68, 1.68)	0.77(0.57, 1.06)	0.79(0.60, 1.03)	0.56(0.41, 0.77)
3 manual	0.72(0.50, 1.03)	0.79(0.35, 0.95)	0.65(0.46, 0.91)	0.52(0.39, 0.69)	0.59(0.43, 0.80)
4 and 5	0.57(0.39, 0.84)	0.72(0.46, 0.98)	0.32(0.22, 0.47)	0.38(0.28, 0.50)	0.63(0.47, 0.86)

*Occupational social class, based on the Registrar General's classification of the person's current or last occupation was used as the principle index of SES. Lower numbers represent lower SES.

It should also be noted that the correlation between SES and vigorous physical activity is significant in all of the occupational classes. The use of occupation is

only one of several methods employed for determining SES. Other measures that have been employed include income and educational levels. In addition, SES may include aspects relating to ethnicity. While research has often looked at SES and ethnicity separately, Winkelby et al. (1999) attempted to determine to what degree each of these variables contributes to health behaviours when included in the same model. They employed data from the NHANES III study in the US, and used two measures of SES, education and income. Respondents were classified as either white, black or Mexican/Mexican-American. Six CVD risk factors were assessed, including smoking status, hypertension, obesity, leisure-time inactivity, hypercholesterolemia and non-insulin dependent diabetes. Education was significantly associated with each of the six CVD risk factors, especially in women. In both men and women, the strongest correlations were found for smoking and leisure-time inactivity. Education, family income, African-American, Mexican-American and age were all found to correlate significantly with leisure-time physical inactivity in women. In men, similar correlations were observed with the exception of Mexican-American. In women, for example, it was found that the odds of leisure-time physical inactivity decreased 16% for each additional year of education (OR=0.84 (0.80, 0.88). A similar trend was found in men (OR=0.83 (0.80, 0.85). Black women were found to have a greater than two fold odds of inactivity as compared to white women (OR=2.26 (1.81, 2.81). Other studies that have reported similar associations between SES and physical activity levels include Droomers et al. (2001), Droomers et al. (1998) and Lindstrom et al. (2001).

While the previous studies focused on individual measures of SES, such as income and educational levels, researchers will often look at the community or area SES instead. In one study, conducted using interviews from 9,240 adult men and women in Sweden, those residing in the most deprived neighbourhoods were significantly more likely to smoke (OR=1.69 (1.42, 2.01), be obese (OR=1.61 (1.34, 1.93) and be physically inactive (OR=1.18 (1.02, 1.36), compared to those residing in the most affluent neighbourhoods after adjustment for individual SES levels (Sundquist et al. 1999). Yen et al. (1998) studied the relationship between residence in a poverty area and change in physical activity levels through time among 1,737 Oakland, California respondents of the Alameda County study surveyed in 1965 and in 1974. They determined that those living in poverty areas had lower baseline levels of physical activity than those residing in non-poverty areas. In addition, those residing in poverty areas experienced a greater decline in physical activity levels with time, independent of other variables including smoking, race, individual income and education (β= -0.59 $p<0.001$).

2.5.4 Environmental variables

This category of variables includes a wide range of factors, such as climate, community aesthetics, and access to facilities. One of the initial studies conducted in this field objectively measured proximity to exercise facilities of 2,053 participants, in San Diego, California (Sallis et al. 1990). An exhaustive list of exercise facilities within the City of San Diego was compiled, using telephone

directories, local publications, and other publicly available means. Bike paths and private facilities were not included in the assessment. Facilities were then categorised as either "free" or "pay". For example, free facilities included parks and sports fields (as identified through the city parks department), public recreation centres, colleges, universities, and public schools. Pay facilities included tennis courts and racquet clubs, aerobic and dance studios, and facilities requiring memberships. These facilities were mapped, and then the distance from the respondent's home to each facility was determined, up to a distance of five kilometres. Based on these results, a variable was constructed indicating the density, or concentration, of exercise facilities around the respondent's home, in one-kilometre increments. Two levels of physical activity were used; sedentary and exerciser, with those in the exerciser group participating in vigorous physical activity at least 3 times per week. The density variable was then correlated with physical activity, and the results indicated that the proximity to the "free" facilities was not significantly associated with vigorous exercise. However, the density of "pay" facilities was significantly associated at each of the one-kilometre increments (Table 5).

Table 5- Differences in density, or average number "pay" exercise facilities located within the indicated distance from respondents' homes, between vigorous exercisers and sedentary respondents (Sallis et al. 1990).

Distance from respondents' homes	Density of "pay" facilities	
	Vigorous exerciser	Sedentary
1km	0.4	0.3
2km	1.0	0.8
3km	1.7	1.4
4km	2.5	2.2
5km	3.5	3.1

All have $p<0.01$

The authors hypothesized that perhaps respondents were unaware that the "free" facilities, which included school gymnasiums, were actually available for public use. This could have biased the results, because respondents would not have made use of such facilities, regardless of their physical proximity. If this was indeed the case, then this study indicates that there exists a clear trend towards increased vigorous activity with respect to proximity of facilities. One limitation of this analysis is that it is cross-sectional. Thus, it cannot establish whether the proximity to facilities lead people to become active, or whether those who are active would be attracted to a particular neighbourhood based on the availability of facilities. An important strength of this study is the use of an objective measure of the environment, the advantages of which will be discussed below.

Another study that used objective environmental measures was conducted by Craig et al. (2002) in order to investigate the effects of community aesthetics on physical activity, specifically the proportion of people walking to work. This study merged data from two sources; the 1996 Canadian Census, and a neighbourhood study. The neighbourhood study was conducted in a convenience sample of 27 communities of known diversity of urban design, social class and economic status located in Quebec, Alberta and Ontario. In each province, an urban centre, a nearby suburban centre, and a small urban centre were selected. Trained observers, using a list of environmental items and a 10-point Likert scale, assessed the neighbourhood environment of each community. The environmental items assessed by the observers included number of destinations (facilities, schools, parks, other locations), inclusiveness of pedestrians

(assessing whether people of different ages, genders, cultures would all feel comfortable walking), social dynamics, walking routes, walking systems, visual interest and aesthetics, traffic, and safety from crime. Results from hierarchical linear modelling indicated that environmental aesthetics were positively correlated with walking to work. For urban centres, it was found that a one-unit increase in the environment score was associated with a 25% increase in the percentage of residents who reported walking to work (t [25]=3.32, p=0.003). This effect was somewhat dependant on the degree of urbanisation, and was thus less pronounced in the small urban and suburban centres (t [23]=-3.61, p=0.002) and t [23]=-4.42, p=000). When urbanisation was taken into account, the environment score remained correlated with the percentage of those walking to work (t [23]=2.03, p=0.054). In contrast, the authors reported that income, university education and percentage living in poverty were not associated with walking to work.

While these two studies employed objective environmental measures, many of the studies in this field have used subjective measures, which raises the important issue of perceived versus actual barriers. It has been hypothesised by some researchers (Humpel et al. 2002, Sallis et al. 1990), that individuals who are inactive will report barriers to activity simply as a reflection of their perceptions. In an attempt to resolve this issue, Troped et al. (2001) surveyed 1,002 adult men and women in Arlington, Massachusetts regarding their physical activity behaviour, as well as relevant aspects of their community and environment. Respondents were asked about neighbourhood safety, access to

bikeways, and their utilisation of the local bikeways. Researchers then used GIS software to objectively determine respondents' proximity to the bikeway, as well at the presence of barriers that might exist between the respondent's home and the bikeway. Two models were constructed; one using the self-reported environmental measures, and the other using the GIS measures, with remarkably similar results. In the first model, distance to the bikeway was significantly associated with decreased use (OR=0.65 (0.54, 0.79) for every 0.25 mile increase in distance). The results from the second model were very similar (OR=0.58 (0.45, 0.73). This study therefore provides some support to the use of subjective measures of the environment. A summary of the studies that have examined environmental variables in a subjective manner can be found in Table 6.

Table 6- Summary of the cross-sectional studies of the association between the environment and physical activity in which environmental variables were measured subjectively.

Reference	Population	Measure of environ-mental variables	PA measure	Main findings
CDC 1999	12676 M and F* adults, U.S.	Neighbour-hood safety, Subjective	Not given	Neighbourhood safety associated with decreased physical inactivity. In M prevalence of inactivity 30.7% for "extremely safe", 36.7% for "not at all safe". In women, 33.8% for "extremely safe", 47.2% for "not at all safe".
Booth et al. 2000	449 M and F adults, >60 years, Australia	Facility, park and equipment access, subjective.	Dichoto-mized into active or not, based on self-report	Access (yes) OR=1.14 (1.03, 1.26) and perceived safety (no) OR=0.57 (0.34, 0.97) were significant.

Table 6- Summary of the cross-sectional studies of the association between the environment and physical activity in which environmental variables were measured subjectively.				
Reference	Population	Measure of environ-mental variables	PA measure	Main findings
Ball et al. 2001	3392 M and F adults, Australia	Facility access, aesthetics, safety, all subjective	Assessed walking for exercise only	Aesthetics (reference low) OR=0.59 (0.47, 0.75) and access (reference low) OR=0.64 (0.54, 0.77) associated with likelihood of walking.
Jakicic et al. 1997	98 M and 96 F adults, U.S.	Presence of equipment in the home	Grouped into Low, moderate or high exerciser, based on self-report	Significant ($p<0.05$) partial correlations between total equipment in the home, and heavy (0.16), moderate (0.14) and total activity (0.19).
Hovell et al. 1989	2053 M and F adults, U.S.	Home equipment, facility access, neighbour-hood, all subjective	Frequency and duration of walking for exercise	Neighbourhood environment correlated ($\beta=0.050$, $p=0.02$), with walking for exercise

*M refers to male participants, F to female.

Thus, for the most part, environmental variables, whether objectively or subjectively measured, are associated with a physically active lifestyle. However, the results of these studies must be interpreted with caution, due to the lack of longitudinal studies in this area of research.

2.5.5 Psychosocial factors

This area of physical activity research has received a great deal of attention, yet remains the most controversial. These variables stem from some of the theories that were outlined in the previous section. The theory that has been most widely

applied to the field of physical activity research is Bandura's SCT. Two important concepts from this theory have been studied in physical activity research, self-efficacy and social support. A summary of these studies can be found in Table 7 (cross-sectional) and 8 (longitudinal).

Table 7- A summary of recent cross-sectional studies of the influence of psychosocial factors on physical activity.

Reference	Population*	Physical activity (PA) assessment	Psychosocial factors examined	Main findings	Comments
Stahl et al. 2001	3343 adult M and F, European	One question, yes/no	Social support (SS) from friends, family, media, politicians, medical professionals.	SS from personal environment (friends, family, etc.) (OR=2.15 (1.72, 2.68)	- Response rate=50% - Only one question used to assess PA
Ball et al. 2001	3392 adult M and F, Australian	Walking for exercise, frequency and duration. Dichotomized; Any vs. No walking in past 2 weeks.	Company during physical activity (yes/no).	No Company vs. Company (OR=0.69 (0.59, 0.80). Effect stronger in women.	- Assessed only walking
Sternfeld et al 1999	2636 adult F, US	8 items regarding usual level of participation in occupational activity, 3 items sports and exercise, 4 items on active living. Also open questions on type of activities, hours/week, months/year. Added household/ caregiver questions (11 items).	Questions pertaining to 3 constructs; self-efficacy (SEF), social support (SS) and perceived barriers. SEF assessed by 3 items, SS assessed by 3 items, for perceived barriers respondents were asked to what degree 15 different factors acted as barriers to activity.	SEF (high) OR=6.11 (4.74-7.88) exercise, 2.17 (1.78-2.65) active living. SS (high) OR=3.05 (2.51-3.69) exercise, OR=2.13 (1.78-2.55) active living	-Due to detailed assessment of PA, results are complex. - Low response rate (<60%)

Table 7- A summary of recent cross-sectional studies of the influence of psychosocial factors on physical activity.					
Reference	Population*	Physical activity (PA) assessment	Psychosocial factors examined	Main findings	Comments
Spanier et al. 2001	29135 M and F adults, 18-59 years, Canada	Assessed frequency, duration and intensity of LTPA	Factor analysis of social support (SS) variables resulted in 4 factors; Familial Structure (parental and marital status), Social Quantity (# of close friends and relatives), Functional Support (emotional and instrumental support) and Social Frequency (frequency of meeting close friends and relatives).	Social Frequency β=0.052 and Social quantity β=0.083 both significant ($p<0.001$)	-Canadian population (Ontario) -Very large N, therefore significance could be influenced by this. - SS is measured in general terms, and not specific to PA.
Bourdeaudhuij et al. 2002	979 16-25 yr. old, 751 35-45 yr. old, 660 50-65 yr. old M and F, Belgium	Assessed frequency, duration, and intensity of LTPA	Social influences (SI); 33 items, Self-efficacy (SEF); 11 items, perceived benefits; 20 items, perceived barriers; 20 items.	Social influences: For M; 16-25 yrs. F=4.51, 35-45 yrs. F=4.37 50-65 yrs. F=6.41. For F; 16-25 yrs. F=2.39, 35-45 yrs. F=4.40, 50-65 yrs. F=2.23. SEF: For M; 16-25 yrs. F=11.75, 35-45 yrs. F=4.25, 50-65 yrs. F=9.04. For F; 16-25 yrs. F=4.44, 35-45 yrs. F=6.02, 50-65 yrs. F=6.83. All results are sig. at, $p<0.05$.	-Belgian population -Population stratified by age and sex, therefore differences based on these can be observed.

* F refers to females, M to males.

Table 8- A summary of recent the longitudinal studies of the influence of psychosocial factors on physical activity.					
Reference	Population* / Follow up	PA definition	Psychosocial factors assessed	Main findings	Comments
Sallis et al. 1992a	1719 adult M and F, US, 24 month follow up	Freq. of vigorous act., as sedentary, intermediate, or active (categorised at both baseline and follow up)	Social variables (16 items), including social support (SS) from friends and family. Cognitive variables (37 items) including perceived benefits and barriers, and self-efficacy (SEF).	SEF predicted PA adoption in initially sedentary M and F (β=0.247, p=0.0001 and β=0.14, p=0.02 respectively). SS predicted adoption in initially sedentary F (β=0.70, p=0.03 for friends, β=0.61, p=0.03 for family)	-Due to PA classification, and stratification by sex, results are complex. However, study demonstrates differences between men and women, and between adopters and maintainers.

Table 8- A summary of recent the longitudinal studies of the influence of psychosocial factors on physical activity.					
Reference	Population* / Follow up	PA definition	Psychosocial factors assessed	Main findings	Comments
Sallis et al. 1992b	1739 adult M and F, US, 24 month follow up	- Self-reported VA, freq. per week. Exercise Change variable created, using baseline and follow up info. Second variable, Months Active, also used.	Same as above	Using Exercise Change; Baseline SEF β=0.036, p=0.001, SEF change β=0.221, p=0.001, barriers change β=-0.135, p=0.001, SS change β=0.092, p=0.001 (family) β=0.079, p=0.003 (friend) Using Months Active; Baseline barriers β= -0.084, p=0.001, baseline SEF β=0.037, p=0.001, baseline env. β=-0.046, p=0.01, SEF change β= 0.198, p=0.001, barriers change β= -0.131, p=0.001, SS β=0.059, p=0.02 (friend) β= 0.079, p=0.002 (family)	-Use of change variables for both outcome (PA) and predictors (SEF, SS etc) yields interesting results. Evidence that Not only baseline var., but also change in these is a predictor of change in PA.

* M refers to males, F to females.

These results highlight some interesting points regarding the use of psychosocial variables in physical activity research. First, research involving psychosocial determinants of physical activity focuses largely on two constructs,

self-efficacy and social support, both of which have roots in Bandura's SCT. Second, statistically significant associations have been found between these two constructs and physical activity in both cross-sectional and longitudinal studies, thus lending credence their use in physical activity research. In addition, the change in these psychosocial variables over time is significantly associated with physical activity change (Sallis et al 1992b). This result supports the concept of reciprocal determinism, which, as discussed previously, is a central component of SCT.

Low levels of physical activity are of particular concern in communities of low SES, as SES is consistently associated with morbidity and mortality, both all-cause and CVD-related (Blakely et al. 2003, Winkelby et al. 2003, Winkelby et al. 1998). As such, those living in communities of low SES present an important target for public health initiatives designed to decrease CVD risk factors. The last section of this review discusses the correlates and determinants of physical activity that have been identified in communities of predominantly low SES.

2.6 Correlates of physical activity in predominantly low SES communities

Only two studies have examined the correlates of a physically active lifestyle in low SES communities. The first study was a cross-sectional self-administered survey of 2,214 adolescents in grades 9 and 11 in a low SES community in San Diego, California (Zakarian et al. 1994). The frequency and duration of vigorous physical activity was assessed, by measuring activities

undertaken both during and outside of school hours. In boys, the variables that were found to explain the most variance were grade, self-efficacy, friend support, perceived benefits of exercise, cigarette smoking, perceived barriers to exercising and body image. In females, the correlates were self-efficacy, perceived barriers, family support, grade, unfavourable attitude toward physical education, alcohol consumption, BMI, and perceived benefits.

The second study, by Eaton et al. (1993) used data collected from adults aged 18 to 64 in two demographically similar communities which participated in the Pawtucket Heart Health Program. One community was assigned an intervention program in an attempt to modify risk factors for cardiovascular disease such as obesity, sedentary lifestyle and smoking. The control community received no intervention, and was blinded to its status. The communities were of predominantly low SES, with mean per capita income of $6,328 and $5,431 in the intervention and control community respectively. The percentage of participants with a high school education was 49.8% and 38.1%. Baseline data were collected in 1981-82, with follow up data collected in 1986-87 and in 1990-91. Physical activity was categorised into four groups; sedentary, adopters, maintainers and quitters. Polychotomous logistic regression analysis was used to determine the ratio of the relative risk (RRR) for each category of physical activity change as compared to sedentary for a variety of predictor variables (See Table 9).

Table 9- Ratio of the relative risk (RRR) and 95% confidence intervals (CI) for each category of physical activity change compared to sedentary for each predictor variable, in men and women, analysed using polychotomous logistic regression (Eaton et al. 1993).

	*Maintainers***				*Adopters***			
Predictors	Men		Women		Men		Women	
	RRR	95% CI	RRR	95% CI	RRR	95% CI	RRR	95% CI
Previous success with exercise	3.4	(1.6, 7.2)	4.4	(2.3, 8.6)	NS*	NS	2.1	(1.2, 3.9)
Previous success with weight loss	NS	NS	3.4	(1.8, 6.3)	2.4	(1.2, 4.7)	2.0	(1.2, 3.3)
Health belief that exercise reduces CHD	5.2	(2.2, 11.9)	NS	NS	2.4	(1.2, 4.7)	NS	NS
Children recommend exercise	NS	NS	11.4	(4.2, 31.1	NS	NS	NS	NS
Cholesterol > 240mg/dL	2.7	(1.2, 6.2)	NS	NS	NS	NS	NS	NS

	*Quitters***			
Predictors	Men		Women	
	RRR	95% CI	RRR	95% CI
Previous success with exercise	NS	NS	4.1	(2.3, 7.6)
Organisation membership	5.0	(1.7, 14.9)	NS	NS
Diabetes	3.2	(1.1, 9.1)	NS	NS
Education more than 12 years	NS	NS	2.2	(1.2, 4.2)

*NS indicates the results were not significant

**Maintainers are those whose physical activity levels remained unchanged from baseline to follow up. Adopters are those whose physical activity levels increase from baseline to follow up. Quitters are those whose physical activity levels decreased from baseline to follow up.

The results of this study indicate several interesting points. First, men and women had different predictors for exercise change. Second, the predictors were different depending on the category of exercise change. The predictors for those

who maintained their levels of physical activity were different than those whose level of activity increased or decreased over time. This study did have some limitations, including a 50% loss to follow up. As well, the use of polychotomous logistic regression, while allowing for the differentiation between the four groups based on exercise change, renders the interpretation of the results somewhat difficult, because the construction of the RRR is complex. As well, some of the results are counter intuitive. For example, previous success with exercise is a significant predictor of being a quitter in women, as is education over 12 years.

In summary, the review of the literature indicates a variety of variables that have been shown to be associated with the practice of physical activity. These include demographic variables, such as age, sex and SES, environmental variables, such as facility proximity and neighbourhood environment, as well as psychosocial variables, such as self-efficacy and social support. In addition, while the literature indicates the importance of SES in determining health behaviour, only one study could be found that examined the determinants of physical activity change in adults, in a community of low SES.

2.7 Objectives

The objective of the current study was to identify the predictors of decline in physical activity among adults living in two low SES communities in Montreal.

Manuscript

Predictors of the decline in physical activity observed in adults from two communities of low socio-economic status in Montreal, Canada

3.1 Abstract

Objectives: Few studies have documented longitudinal predictors of changes in physical activity rates, particularly in low SES communities. This study assessed the predictors of the decline in physical activity levels observed over the course of a 5-year longitudinal cohort of adults aged 18-65 living in two low-income, inner-city neighbourhoods in Montreal, Canada.

Methods: The current study made use of data collected as part of Cœur en Santé St. Henri, an intervention program designed to decrease cardiovascular disease risk (CVD) factors. A two-stage cluster telephone survey of a representative sample of residents was used to collect information on a variety of lifestyle behaviours. Multiple logistic regression was used to assess the independent predictors of decline in leisure time physical activity in 626 subjects.

Results: Significant predictors of the decrease in physical activity include age (OR=1.0 (1.0, 1.1) and BMI (OR=2.0 (1.1, 3.6), and a composite index assessing self-efficacy pertaining to physical activity (OR=2.0 (1.2, 3.2), in males. In females, significant predictors include lack of energy (OR=2.4 (1.2, 4.6), perceived lack of athletic ability (OR=2.4 (1.1, 5.2), not using a neighbourhood facility for physical activity (OR=2.8 (1.6, 4.7), BMI (OR=2.1 (1.2, 3.7), and a composite index assessing self-efficacy pertaining to physical activity (OR=2.1 (1.3, 3.5).

Conclusions: Factors such as BMI, self-efficacy, and the environment all influence physical activity behaviour over time, and as such, should inform prevention programs.

3.2 Introduction

Although physical inactivity is linked to increased rates of coronary heart disease, type 2 diabetes, certain types of cancer, osteoporosis and poorer mental health and stress management practices (US Department of Health and Human Services 1996, Sallis and Owen 1999), 60% of American adults are not sufficiently active to achieve health benefits from physical activity, and 25% are not active at all (U.S. Department of Health and Human Services 1996). Similarly in Canada, the prevalence of physical inactivity in the adult population has been estimated at 62%. (Health Canada 1999). Because individuals from low socio-economic status (SES) communities have both lower physical activity levels and increased morbidity and mortality compared to high SES communities (Wardle et al. 2001, Winkelby et al. 1999, Yen et al. 1998, Sundquist et al. 1999, Luepker et al 1993), increasing physical activity participation in low SES communities could be an important public health goal.

Several studies have identified factors associated with the adoption and maintenance of physical activity, which can be classified according to demographic factors including age (Sallis 2000, Casperson et al. 2000), sex (USDHHS 1996) and SES, psychosocial factors including social support, self-efficacy, perceived barriers (Stahl et al. 2001, Ball et al. 2001, Sternfeld et al 1999, Sallis et al. 1992a and b), and belief in the benefits of physical activity (Eaton et al. 1993) and environmental factors including access to sports facilities and neighbourhood safety (Sallis et al. 1990, Craig et al. 2002, Troped et al. 2001, CDC 1999, Booth et al. 2000). However, few studies have examined the

predictors of the decline in physical activity using a longitudinal design (Sallis et al. 1992 a and b) and only one study assessed the predictors of change in physical activity in low SES communities (Eaton et al. 1993). Given the limited effectiveness of community-wide efforts at improving physical activity and the gap in physical activity between high and low SES individuals, it appears important to improve our understanding of the factors associated with a physically active lifestyle in this population.

To respond to this need we conducted secondary analyses of data that were collected as part of Cœur en Santé St. Henri, a community-based heart health promotion programme targeting adults in a low-income, inner-city neighbourhood in Montreal, Canada. The available data pertain to cardiovascular (CVD) risk factors including physical activity behaviour, and were collected in a 5-year (1992-97) longitudinal cohort study design. The current study was conducted to identify predictors of declining physical activity in individuals over time.

3.3 Methods

The Cœur en Santé initiative was a four-year (January 1992 to December 1995) community based CVD prevention program targeted to adults aged 18-65 years living in St.Henri, a low-income, low-education neighborhood in southwest Montreal, Canada (Paradis et al. 1995). The impact of the program was assessed in a five-year longitudinal study design by comparing levels of modifiable CVD risk factors among adults in St-Henri to those in a matched comparison community. Subjects were selected using a two-stage neighborhood cluster sampling design. Households in which there were no subjects in the age range of interest; and those in which the subject selected spoke neither French nor English, were excluded. Data were collected in 35-minute telephone interviews at baseline and in the five-year follow-up. Detailed descriptions of the study design and methods are already reported (O'Loughlin et al. 1995, O'Loughlin et al.1999).

3.3.1 Dependent variable

Frequency of Leisure Time Physical Activity (LTPA) was assessed in two questions adapted from the Leisure-Time Exercise Questionnaire (Godin et al. 1985), including: (i) Think back over the past three months. In a typical week, how many hours did you spend in vigorous leisure time physical activity which caused you to perspire and breathe hard?" and (ii) In a typical week, how many hours did you spend in moderate leisure time physical activity, such as brisk walking, bicycling, or heavy gardening?". Responses were categorised as infrequent, moderately frequent, or frequent according to an algorithm that combined hours spent in vigorous and moderate physical activity (Table 1).

Decline in LTPA over time, the primary outcome, was assessed by comparing baseline and follow up LTPA. Subjects who were categorized as having moderately frequent, or frequent LTPA at baseline and infrequent LTPA at follow-up where classified as having experienced a decline in LTPA. Subjects categorized as having infrequent LTPA at baseline were excluded from the analysis, because they were not at risk of a decline in LTPA.

3.3.2 Independent variables

Potential predictors were identified in a thorough review of the literature and included sociodemographic indicators (sex, age, income, level of education), psychosocial variables (social support, self-efficacy, perceived barriers to activity, intention to undertake risk-reducing behaviours), health status, body mass index (BMI), and environmental indicators including the use of a neighborhood facility for exercise.

Social support for physical activity was assessed by: (i) "Is there anyone who is encouraging you to be physically active?", (spouse, children, mother/father, other family member, friend, other). Respondents checked all that applied and responses were coded as none, or one or more persons.

Self-efficacy related to physical activity was assessed in three items: "Tell me if, for you, the following would be easy (scored 1), somewhat difficult (scored 2) or very difficult (scored 3)...1) to exercise even when you feel like doing something else 2) to organize yourself to exercise regularly 3) to try new kinds of physical activity.

Subjects were asked to rate the importance (very, somewhat, not at all important) of 11 barriers to physical activity: 1) lack of time 2) lack of energy 3) lack of athletic ability 4) lack of programs or accessible facilities 5) lack of a partner 6) lack of support from family or friends 7) lack of babysitting services 8) cost 9) lack of self-discipline 10) self-conscious 11) fear of injury. Responses were scored 1 (very important), 2 (somewhat important) or 3 (not at all important).

Principal component analysis (PCA) was conducted to reduce items and create parsimonious indicators of self-efficacy (3-item question) and perceived barriers to physical activity (11-item question). Composite indices were generated for each variable using the Varimax rotation method, and a loading factor of 0.4 was set as the threshold for incorporation of the item into a multi-item index. The internal reliability of each index was assessed using Cronbach's reliability coefficient. Indices with Cronbach's reliability coefficients of less than 0.60 or greater than 0.85 were excluded from subsequent analysis, as values below 0.60 indicate the items comprising the index are not sufficiently well correlated to be grouped together into a multi-item index, and values above 0.85 indicate the items are highly correlated, and therefore not measuring different aspects of the construct.

Summing scores across the three self-efficacy items generated an indicator of physical activity self-efficacy (mean (SD) = 1.79 (0.57); median = 1.67; range 1 - 3; Cronbach's reliability coefficient =0.65). Summing scores across the items 5) and 6) of the 11-item question investigating perceived barriers generated an indicator assessing lack of social support pertaining to

physical activity (mean (SD) = 1.82 (0.43); median = 2.0; range 1 - 3; Cronbach's reliability coefficient = 0.61).

Data on intentions to undertake risk-reducing behaviours relating to physical activity were collected by: "Which of the following do you intend to do to improve your health in the next year?"; 1) increase level of physical activity 2) start a new physical activity 3) lose weight. Respondents could answer; yes, no, already do it.

Access to facilities for physical activities was assessed by: "Where do you usually do your leisure time physical activities?"; (home, park, recreation facility, work, commercial facility or private club, outside (no special facility), school/college/university facility, other). Respondents checked all that applied and responses were coded as none, or one or more, indicating the number of locations at which subjects engage in physical activity. Use of a neighbourhood facility for physical activity was determined by; "During the last year, did you use any of the centres for physical activity in your neighbourhood (for exercising)?".

Attitudes and beliefs regarding physical activity were assessed by; "Do you agree or disagree with the following?": 1) I would like to have more time for physical activity 2) I don't like to be out of breath and sweaty during physical activity 3) part of what I like about physical activity is being with friends 4) the cost of the special equipment needed for exercise are worth it 5) I dislike spending my free time exercising 6) I don't like wearing the special clothes needed for exercise 7) for me, being physically active is a lot of fun.

3.3.3 Data analysis

Because no statistically significant differences were found with regards to changes in physical activity levels between the intervention and control communities (O'Loughlin et at. 1999) data from the two communities were combined for the current analysis. One hundred and forty subjects who were inactive at baseline were excluded because by definition their level of physical activity could not decline over time. All analyses were stratified by sex.

Potential predictors of decline significant at $p<0.1$ in bivariate analyses were retained for multivariate analysis; only those significant at $p= 0.05$ were retained in multivariate analysis. The multivariate analysis employed multiple logistic regression to identify the independent variables that were predictors of a decline in physical activity over the 5 year follow up of the study. All variables that were significant bivariately at $p<0.1$ were added to the multivariate models in a stepwise procedure to check for confounding. All statistical analyses were conducted using SAS 8.2.

3.4 Results

A total of 766 subjects with complete baseline (May 1992) and follow-up (May 1997) data, were available for analysis (48.9% of 1674 subjects who participated at baseline). Subjects lost to follow up were younger, more were male, and more had completed high school, compared to those retained in the study (O'Loughlin et al. 1999)

At baseline, 14.4% of males and 21.5% of females were classified as having infrequent LTPA. At follow up, 29% of males and 39.6% of females were so classified.

At baseline, 18.9% of subjects (n=145) were moderately active in leisure time and 62.8% (481) were frequently active. In 1997, LTPA was categorised as infrequent in 265 (34.5%), moderately frequent in 146 (19%), and frequent in 355 (46.3%) subjects. In all, 190 subjects (24.8%), 73 males and 117 females who had been frequently or moderately frequently active at baseline were classified as infrequently active at follow up (Table 2).

Bivariate associations between selected potential predictors and physical activity decline are presented in Table 3. Variables significantly associated with a decline in physical activity include indicators of social support, lack of discipline, self-efficacy pertaining to physical activity, an intention to loose weight and BMI, in males. In females, variables significantly associated with a decline in activity include self-rated health, indicators of social support, lack of energy, ability, accessibility, and discipline, not using a neighbourhood facility for activity, self-efficacy pertaining to physical activity, the intention to loose weight and BMI.

In multivariate analysis, BMI was a significant predictor of decline in physical activity. Men and women who had a BMI above 25 at baseline had twice the risk of decreasing their level of physical activity in five years. In sub-analyses, the association between BMI and decline in physical activity was verified using the WHO and Health Canada categories of less than 18.5, 18.5-24.9, 25-29.9 and over 30 (Health Canada, 2003). Among men, the OR's (95% CI's) for BMI under 18.5, 25-29.9 and 30 and over were 0.4 (0.2, 1.2) 1.7 (0.9, 3.2) and 2.9 (0.9, 9.7), respectively, when compared to the reference category of 18.5-24.9. Among women, the OR's (95%CI's) were: 0.8 (0.4, 1.7), 2.4 (1.2, 4.7) and 1.3 (0.5, 3.5). While the results of the sub-analysis fail to attain statistical significance, it is evident that increased baseline BMI predicts decreased physical activity at follow-up.

Low self-efficacy for physical activity doubled the risk of decline in physical activity in both men and women. Among women the lack of use of a neighbourhood facility was associated with almost three-fold increase in the risk of decline in physical activity whereas the perceived barriers of lack of energy and lack of ability doubled the risk. Among men the only other significant predictor was age, which increased slightly the risk of decline in physical activity (Table 4).

3.5 Discussion

BMI was a strong predictor of decline in physical activity prevalence, in both men and women. Although it is generally believed that declines in physical activity should lead to excess adiposity (US Department of health and human services 1996), studies have not yielded consistent results (US Department of health and human services 1996, Sallis and Owen, 1999) As well, previous studies have not been able to demonstrate that excess weight predicts decline in physical activity (Sallis and Owen 1999). However, many previous studies were cross-sectional in nature, and thus may not reflect the effect of BMI on habitual physical activity over an extended period of time. A number of longitudinal studies have indicated no association between BMI and physical activity prevalence (Sallis et al. 1986, Sallis et al. 1992a, Eaton et al. 1993). The first two studies were likely limited by short follow up periods, of one and two years, respectively. The effects of obesity on one's ability to be active might require more time to manifest, and thus studies of short duration would not capture this relationship. In addition, the study by Eaton et al was limited by the assessment of vigorous physical activity only. Elevated BMI is associated with a number of adverse health conditions, including osteoarthritis and low back pain (WHO 2000). The presence of such conditions, as well as the fact that physiologically more energy is required to mobilise a larger body mass may restrict the overweight and obese to moderate exercise. Thus, the exclusion of moderate exercisers could inadvertently exclude the overweight and obese as well, and prevent the discovery of an association. In addition, the results of all three studies might have

been affected by the use of measures of self-report to determine physical activity level. Only one study (Eaton et al. 1993) determined BMI objectively, the other two studies used self-reported height and weight. While measures of self-report are used extensively throughout the literature, and reliability and validity of these measures has been reported as good, (USDHHS 1996, Sallis and Owen 1999, Sallis and Saelens 2000) there remains the possibility for misclassification, which would tend to reduce the observed association between BMI and physical activity.

In the current study, physiologic, genetic and psychosocial factors might all contribute to the relationship between BMI and decline in physical activity. As discussed above, the overweight and obese are at an increased risk for orthopaedic conditions, as well as other negative health conditions such as CVD and type II diabetes (WHO 2000, Stunkard and Wadden 1993) all of which might reduce their capacity to exercise over time. Twin studies indicate that genotype influences both physical activity behaviour and the tendency to store excess calories as fat (Bouchard et al 1994, Stunkard and Wadden 1993). However, no genes to date have been discovered that are involved in both processes. Psychosocial factors might play a role in the relationship between BMI and physical activity. Obese and overweight individuals face discrimination in social settings, at work, at school and in the health-care system (Stunkard and Wadden 1993). It is conceivable that these individuals are also experiencing discrimination in physical activity settings. As well, differences in body size are more evident in such settings than they would be in work or social environments, due to the attire

generally worn by those engaging in physical activity. In addition, the physical environment might lack support for the overweight and obese, and equipment commonly used in athletic settings might not be suitable for use by such individuals. The overweight or obese individual might therefore decide to avoid such settings, especially if previous physical activity did not produced the weight loss results anticipated by the individual.

More females were categorised as infrequent with respect to LTPA than males, which is consistent with previously published results (US Department of health and human services 1996, Sallis and Owen, 1999). Also predictors of decline differed by sex. Increasing age was a significant but weak predictor of the decline in physical activity levels, in men only. In a recent cross-sectional study (Casperson et al. 2000), the prevalence of physical activity remained stable through adulthood, with the greatest decline occurring during adolescence, and a smaller decline occurring after age 65 years. While our SES indicators were significant bivariately, neither variable was retained in the multivariate model probably because of insufficient variation in the SES indicators in these two very low SES communities.

Our study indicates that not using a neighbourhood facility is a predictor of decline in physical activity, in women only. Although previous research suggests the importance of environmental factors on physical activity levels (Booth et al. 2000, Ball et al. 2001, Jakicic et al. 1997, Hovell et al. 1989), few longitudinal studies have been conducted. In one prospective study that assessed this relationship, the presence of home equipment, the neighbourhood environment,

and convenience of facilities, predicted adoption of physical activity in initially sedentary men, over a 24 month period (Sallis et al. 1992a). This study was limited as only vigorous physical activity was assessed, and rates of vigorous physical activity are much lower in women (Casperson et al. 2000, Sallis and Owen 1999). An additional limiting factor was the overrepresentation of affluent and well-educated residents, and an underrepresentation of minorities. One possible explanation for our results is that neighbourhood safety exerts an effect in the relationship between neighbourhood facility use and physical activity. No questions were asked regarding the effect of neighbourhood safety, however, women residing in a low-income, inner-city neighbourhood may feel less comfortable engaging in physical activity outside, in streets and parks, while men experience no such discomfort.

The strong effect of the self-efficacy (SEF) measure, in both men and women, is supported by previous research in this field. In a 2-year follow up of men and women in the U.S., baseline SEF was found to predict the adoption of a physically active lifestyle in initially sedentary men and women (Sallis et al. 1992b). As well, change in SEF that occurred over the 2-year period, was also found to be a significant predictor of exercise changes. Sternfeld et al. (1999) found that SEF was associated with both exercise and active living in a population of adult females in the US. Bourdeaudhuij et al. (2002) reported similar results in a study of men and women in Belgium.

Two perceived barriers to activity were found to be significant predictors of a decline in physical activity in women; lack of energy and lack of ability. Results

of previous research are inconsistent with regards to this concept. Cross-sectional studies conducted by Bourdeaudhuij et al. (2002) and Sternfeld et al. (1999) indicate no correlation between perceived barriers and level of physical activity. However, in a 2-year prospective cohort study, Sallis et al. (1992b) found both perceived barriers at baseline, and the change in perceived barriers over the follow up period to be predictive of exercise change

In contrast to previous studies, (Stahl et al. 2001, Ball et al. 2001, Sternfeld et al. 1999, Spanier et al. 2001, Bourdeaudhuij et al. 2002, Sallis et al. 1992 a and b) social support variables were not associated with decline. The 5-year period between questionnaire administrations might have been too long to capture the effect of social support, if social support is time-dependent. (Sallis et al.1992b).

According to national data, 57% of adult Canadians are inactive (Health Canada, 1999), however in the current study, at baseline, only 18.3% of participants were categorised as having infrequent LTPA. It is likely that the large discrepancy results from the fact that different cut-off points were used to categorize the inactive subjects. For the Health Canada data, those expending less than 1.5 Kcal /kg/day in leisure time physical activity were said to be inactive. For the current study those reporting less than 1 hour of vigorous activity, and less than 3 hours of moderate activity per week were considered to be inactive. A study published by the US Department of Health and Human Services (1996), which used cut-offs similar to those used in our study, reported rates of physical inactivity ranging from 24.3% to 28.7% in adults.

3.5.1 Limitations

Because the current study is a secondary analysis of existing data, the variables available for the analysis were limited to those that were included in the original study. Few environmental measures were included in the questionnaire, and no objective environmental measures were collected. As well, the 2 multi-item questions that were used in the PCA were not designed to be used in this manner, thus limiting the utility of the PCA analysis. For example, the questions used to assess self-efficacy gave only three response choices, which is not ideal for PCA analysis, nor is it recommended for the assessment of self-efficacy. While the long follow-up of this study is a definite strength, the long period of time between questionnaire administrations may have resulted in misclassification with regards to the dynamic psychosocial variables.

As well, the measure used to determine levels of physical activity, while valid and reliable, might not be ideal. The measure developed by Godin and Sheppard (1985) was developed to be a rapid, yet effective measure for determining level of physical activity, and was therefore a good choice for a study examining a range of CVD risk factors. However, future research, designed to study only physical activity, should perhaps use more detailed measures. In addition, BMI was based on self-report measures of height and weight, and thus this variable may be subject bias. However, as the tendency would be to over-report height and under-report weight, the result would be reported BMI values which are lower than the actual values of BMI. This would serve to reduce any observed association between BMI and physical activity, and thus if the BMI results are

indeed biased in this manner, the true association would be larger than the observed association reported here.

3.6.1 Table 1

Table 1- Categorisation of Leisure-Time Physical Activity for the Coeur en Santé St. Henri Study, 1992-1997.

Hours of vigorous leisure-time physical activity per week	Hours of moderate leisure-time physical activity per week	Category of leisure-time physical activity
3 or more	Any	Frequent
More than 1, less than 3	5 or more 3 or more, less than 5 Less than 3	Frequent Moderately frequent Moderately frequent
Less than1	5 or more 3 or more, less than 5 Less than 3	Frequent Moderately frequent Infrequent
Missing	Missing Less than 3 3 or more, less than 5 5 or more	Missing Infrequent Moderately frequent Frequent

3.6.2 Table 2

Table 2- Leisure Time Physical Activity status at follow up (1997), by baseline (1992) Leisure Time Physical Activity status, stratified by sex, in adults living in low-income, inner-city communities in Montreal, Canada.

			Follow-up status		
Gender	Baseline	(n)	Infrequent (%)	Moderately Frequent (%)	Frequent (%)
Males	Moderately Frequent	57	35.1	21.1	43.9
	Frequent	238	22.3	17.2	60.5
Females	Moderately Frequent	88	48.9	23.9	27.3
	Frequent	243	30.5	19.3	50.2

3.6.3 Table 3

Table 3- Bivariate associations between selected potential predictors and physical activity decline in adults living in low-income, inner-city communities in Montreal, Canada, 1992-1997.

	Males			Females		
	n	Declined %	p-value	n	Declined %	p-value
Self-rated health						
Excellent	N/A*	N/A	N/A	46	41.4	0.02
Good				63	47.0	
Average				38	63.3	
Poor				8	80.0	
Heart problems						
No	95	36.7	0.39	140	48.8	0.90
Yes	13	44.8		15	50.0	
No. people with whom PA** is done in leisure time						
None	48	44.9	0.05	53	53.0	0.32
One or more	60	33.2		102	47.0	
Number of places where subject engages in PA						
None	5	50.0	0.41	8	61.5	0.35
One or more	103	37.1		147	48.4	
Number of people seen socially who engage in PA						
None	10	66.7	0.05	23	71.9	0.009
A few	47	40.9		71	49.0	
About half	23	36.5		25	40.3	
Most or all	26	29.5		30	42.3	

	Males			Females		
	n	Declined %	p-value	n	Declined %	p-value
Number of people encouraging activity						
None	75	38.9	0.50	90	47.4	0.51
One or more	33	34.7		65	51.2	
Lack of social support for PA						
1 (Very important)	4	57.1	0.47	9	90.0	0.05
1.5	1	20.0		10	52.6	
2	22	44.9		27	57.5	
2.5	23	33.3		24	43.6	
3 (Not at all important)	58	36.7		85	45.7	
Lack of time						
Somewhat/ Not at all important	74	38.7	0.54	111	50.5	0.40
Very important	34	35.0		44	45.4	
Lack of energy						
Somewhat/ Not at all important	101	37.6	0.95	115	44.4	<0.001
Very important	7	36.8		40	69.0	
Lack of ability						
Somewhat/ Not at all important	101	37.6	0.95	125	45.3	<0.001
Very important	7	36.8		30	73.2	

	Males			Females		
	n	Declined %	p-value	n	Declined %	p-value
Lack of accessibility						
Somewhat/ Not at all important	101	38.7	0.19	135	47.2	0.07
Very important	7	25.9		20	64.5	
Lack of partner						
Somewhat/ Not at all important	96	36.5	0.26	128	47.1	0.11
Very important	12	48.0		27	60.0	
Lack of babysitting services						
Somewhat/ Not at all important	N/A	N/A	N/A	147	48.4	0.35
Very important				8	61.5	
Lack of social support						
Somewhat/ Not at all important	103	37.1	0.41	142	47.5	0.04
Very important	5	50.0		13	72.2	
Cost						
Somewhat/ Not at all important	98	34.6	0.83	128	47.9	0.43
Very important	10	50.0		27	54.0	
Lack of discipline						
Somewhat/ Not at all important	83	34.7	0.03	114	45.6	0.02
Very important	25	51.0		41	61.2	

	Males			Females		
	n	Declined %	p-value	n	Declined %	p-value
Use of neighbourhood facility						
No	52	39.6	0.24	124	56.9	<0.001
Yes	26	32.1		31	31.3	
Subject would like more time for PA						
Agree	69	36.1	0.50	104	48.6	0.88
Disagree	39	40.2		51	49.5	
Subject doesn't like being out of breath, sweating						
Agree	31	38.8	0.41	61	57.6	0.03
Disagree	76	36.7		94	44.6	
Part of what subject likes about PA is being with friends						
Agree	78	38.6	0.55	107	49.3	0.83
Disagree	30	34.8		48	48.0	
The costs of equipment are worth it						
Agree	79	37.6	0.43	101	45.5	0.18
Disagree	28	36.4		53	57.0	
Subject dislikes spending free time doing PA						
Agree	17	46.0	0.09	33	55.9	0.31
Disagree	89	35.7		122	47.5	

	Males			Females		
	n	Declined %	p-value	n	Declined %	p-value
Subject doesn't like wearing exercise clothes						
Agree	30	44.1	0.18	47	54.7	0.26
Disagree	77	35.2		107	46.5	
Being active is fun						
Agree	102	37.2	0.67	134	46.5	<0.001
Disagree	6	42.9		21	72.4	
PA self-efficacy						
1 (high SEF)	14	26.4	0.08	15	31.9	<0.001
1.33	13	25.0		31	41.3	
1.67	31	41.9		24	36.4	
2	24	45.3		45	68.2	
2.3	15	45.5		19	54.3	
2.67	7	58.3		11	64.7	
3 (low SEF)	4	36.4		10	90.9	
Plan to increase level of activity						
No	28	39.4	0.18	33	47.8	0.05
Yes	64	40.5		103	53.4	
Already do it	16	26.7		19	34.6	
Plan to start a new PA						
No	66	39.1	0.47	88	59.7	0.14
Yes	42	35.9		67	49.3	
Plan to lose weight						
No	55	31.3	0.02	52	36.7	0.02
Yes	50	47.2		99	55.9	
Already do it	3	42.9		4	44.4	

	Males			Females		
	n	Declined %	p-value	n	Declined %	p-value
Income sufficiency						
1 (low)	21	35.0	0.70	55	59.8	0.06
2	28	40.0		35	43.8	
3	49	35.8		48	42.5	
4 (high)	10	47.6		19	53.1	
Education						
Elementary	6	66.7	0.22	15	79.0	0.28
Some secondary	16	43.2		26	51.0	
Completed secondary	24	44.4		27	46.6	
Some CEGEP, technical school	4	28.6		8	50.0	
Completed CEGEP	19	39.6		19	44.2	
Some university, teacher's college	7	29.2		12	38.7	
Completed university, teacher's college	31	31.3		44	47.8	
BMI						
≤25	73	33.5	0.01	102	43.2	<0.001
>25	35	50.0		53	65.4	

* N/A indicates data is not available, due to small number of subjects in one or more categories.
**PA- Physical activity

3.6.4 Table 4

Table 4- Adjusted odds ratios* and 95 percent confidence intervals for decline in physical activity among adults in low-income, inner-city neighbourhoods in Montreal, Canada, 1992-1997.

Independent predictor	Males (n=288) OR (95%CI)	Females (n=317) OR (95% CI)
BMI		
≤25	Ref.	Ref.
>25	1.99 (1.11, 3.60)	2.10 (1.19, 3.69)
Age (years)	1.03 (1.01, 1.06)	NS**
Physical activity self-efficacy	1.96 (1.21, 3.17)	2.13 (1.30, 3.49)
Uses a neighbourhood centre for physical activity		
Yes	NS	Ref.
No		2.77 (1.61, 4.74)
Lack of energy	NS	2.36 (1.21, 4.60)
Lack of athletic ability	NS	2.36 (1.06, 5.21)

*Odds ratios were adjusted for other independent variables shown in the table
**NS-Not significant

4. Conclusion

The current study involves a secondary analysis of data that were collected as part of an intervention program targeted at a low-income, inner-city neighbourhood in Montreal, Canada. It has been well established that socio-economic status (SES) is associated with decreased physical activity and increased morbidity and mortality (Wardle et al. 2001, Winkelby et al. 1999, Yen et al. 1998, Sundquist et al. 1999). However, few studies have attempted to identify correlates or predictors of physical inactivity in such communities. In addition, while the literature contains a large number of cross-sectional studies, the longitudinal studies required to establish causation are far fewer. The current study provides the opportunity to determine the predictors of change in physical activity levels, in communities of low SES.

Significant predictors of decline in LTPA included BMI, age, and physical activity self-efficacy, in men. In women, significant predictors were BMI, not using a neighbourhood facility for physical activity, perceived barriers of lack of energy and lack of ability, and self-efficacy with respect to physical activity.

This study is the first to identify BMI as a significant predictor of decline in physical activity. Previous research indicated BMI had no effect on physical activity decline (Sallis and Owen 1999). In our study, physiologic, genetic and psychosocial factors might all contribute to the relationship between BMI and decline in physical activity. The overweight and obese might be at an increased risk of exercise related injuries, which could lead to the abandonment of a physical activity regimen. The overweight and obese experience discrimination in

a variety of settings (Stunkard and Wadden 1993), and it is likely that such discrimination is felt more acutely in an exercise setting. Genetic studies indicate genetic links for both obesity and physical fitness, and while no genes have yet been identified which are implicated in both conditions, the possibility remains that a genetic effect is implicated between BMI and physical activity decline.

Self-efficacy was found to be a significant predictor of physical activity decline, in men and women, a result which is supported by previous studies. As well, perceived barriers to activity, such as the lack of ability and energy, were also found to be significant, in women only. Previous studies have yielded conflicting results with respect to such variables (Bourdeaudhuij et al. 2002, Sternfeld et al. 1999, Sallis et al. 1992b), with some researchers hypothesising that those who are active make the decision to overcome such barriers, while the inactive do not (Dishman et al. 1985).

The use of a neighbourhood facility for physical activity was found to be a significant predictor, in women only. Previous studies have examined a range of environmental variables, using both subjective and objective environmental measures, with all but a handful yielding significant results (Humpel et al. 2002. Craig et al. 2002, Sallis et al. 1990, CDC et al. 1999, Booth et al. 2000, Ball et al. 2001, Jakicic et al. 1997, Hovell et al. 1989). The results of the current study may be due to the low SES of the communities in which the data were gathered. Neighbourhood safety may exert an effect, which would affect women to a greater degree than men. Thus, women would require a neighbourhood facility in order to be physically active, while men might feel safe engaging in activities in

neighbourhood parks, and on the streets. However, as the current study collected no data assessing neighbourhood safety, no conclusions can be drawn.

Our study indicates several implications for intervention programmes designed to target physical inactivity at the community level. The importance of BMI in physical activity decline suggests that current physical activity regimens may be excluding the overweight and obese. This is of particular importance as physical inactivity and obesity are associated with many of the same negative health outcomes, including cardiovascular disease (WHO 2000, Stunkard and Wadden 1993). Future public health initiatives may require the design of programmes specifically targeted at increasing activity in the overweight and obese, such as group environments where all participants are overweight, and the design of exercise regimens which take into account the physiologic implications of exercising while overweight. As well, the equipment currently employed in exercise programmes, such as treadmills and strength training equipment may need to be re-designed with the needs of this population in mind. This study also indicates the importance of access to facilities for women in these two communities.

This study raises several issues which need to be addressed in future research. First, as this is the first study to demonstrate the association between BMI and physical activity decline, further research is required. Future studies should determine whether this relationship is unique to populations of low SES. As well, studies should be conducted to establish the cause of this association, so that intervention programmes can be designed to specifically target the

overweight and obese. The current study was limited by the long period of time between data collections. Future studies should collect data with an increased frequency, so that changes in both predictor and outcome variables could be captured over shorter time intervals. In addition, while the measure of Godin and Sheppard (1985) has proved both valid and reliable (Kriska et al. 1997), it may be useful to employ measures which assess physical activity in greater detail. As well, new measurement and statistical methodologies are now available to researchers in the field of physical activity research. The use qualitative assessment tools, employed in focus groups, in-depth interviews and observational studies have the potential to help researchers generate or revise conceptual frameworks and models (Mâsse et al. 2002). The use of multilevel modeling, while it has not as of yet gained wide acceptance, will perhaps provide future researchers with the ability to conceptualize the hierarchical nature of physical activity behaviour (Mâsse et al. 2002).

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Appendix I

Appendix II

Appendix III

Dossier

UPI

Coeur en santé - Population Survey

Baseline Questionnaire

1. **Interviewer**

1 _____

2 _____

3 _____

2. **Household sticker**

3. **Phonecall register**

	Date Day Month	Begin Hr. Min.	End Hr. Min.	Number of min.	Result	Comments
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						

Result Codes:

1. No answer
2. Answering machine
3. Busy
4. Out of service
5. Nobody from household home.
6. Respondent refused
7. Subject not available
8. Subject refused - illness
9. Subject refused - other reason
10. Ineligible
11. Rescheduled
12. Interview partially completed
13. Interview completed
14. Other

4. **Message for answering machine:** Hello! My name is _____. I work for the Heart Health Program of the Montreal General Hospital. We are conducting a survey in your area to collect information which will enable us to develop effective heart disease prevention programs. I will call back later. Thank you.

Message pour répondeurs : Bonjour! Mon nom est _____. Je travaille pour le programme "Coeur en santé" de l'Hôpital général de Montréal. Nous faisons une enquête actuellement dans votre quartier, afin de recueillir de l'information pour bâtir des programmes efficaces pour prévenir les maladies du coeur. Je vous rappellerai plus tard à ce sujet.

5. Good morning/afternoon. Could I speak with Mr. or Mrs. _____. My name is _____. I work for the Heart Health Program of the Montreal General Hospital. We are conducting a survey in your area as part of a community-wide heart disease prevention program. We recently sent a letter to your household describing this project. **Did you see the letter?**

1 Yes 2 No

(As described in the letter) the purpose of this survey is to learn more about your neighbourhood in order to discover better ways of preventing heart disease. The interview therefore includes questions about eating habits, physical activity and use of tobacco.

Bonjour. Est-ce que je peux parler à monsieur/madame _____. Je m'appelle _____. Je travaille pour l'Hôpital général de Montréal avec l'équipe Coeur en santé. Nous faisons actuellement une enquête dans votre quartier qui fait partie d'un programme communautaire de prévention des maladies du coeur. Nous avons récemment envoyé, à votre ménage, une lettre expliquant ce projet. **L'avez-vous vue?**

1 Oui 2 Non

(Tel qu'indiqué dans la lettre), le but de cette enquête est de mieux connaître votre quartier afin de découvrir des moyens efficaces pour améliorer la santé du coeur. Nous allons donc poser des questions sur les habitudes alimentaires, l'activité physique et le tabagisme.

6. In order for the survey to be representative, an adult member of your household must be randomly selected for interviewing. **Could you tell me the names and ages of all persons living in this household?** Be sure to include people who usually live in the household but are away temporarily (students, persons hospitalized or on vacation). Could we begin with the oldest person.

Cependant, pour que notre information soit représentative, il faut choisir au hasard un membre adulte de votre ménage. **Pourriez-vous m'énumérer les noms et les âges de toutes les personnes vivant dans ce ménage?** Donnez-moi même les personnes qui sont absentes temporairement mais qui vivent habituellement dans le ménage (les personnes en vacances, hospitalisées ou étudiantes). Commençons par la plus âgée.

	Nom de fille (Maiden) Name	Prénom First Name	Age

7. Total number of person in household

_____

8. Selection sticker

1	2	3	4	5	6	7	8	9	10	11	12
1	1	1	1	5	3	4	8	2	4	1	11

Interviewer: Number persons aged 18-65 from 1 to ....., beginning with the oldest. Choose the person to be interviewed using the selection sticker. Circle the number of the person selected.

9. **The person I must interview is**

_____

Name of person to be interviewed

Would it be possible to speak with you/him/her now?

1 Yes
2 No → **Interviewer:** Make arrangements for another interview

La personne que je dois interviewer est

_____

Nom de la personne sélectionnée

Est-ce que c'est possible de vous/lui/elle parler présentement?

1 Oui
2 Non →**Interviewer:** faire les arrangements pour une autre entrevue

10. **Respondent selected as subject.** Before beginning I would like to thank you for your participation and let you know that all the information which you provide is strictly confidential. The interview will take about 25 min. I'll begin with some general questions about your health.

Respondent not selected as subject Good morning/afternoon Mr/Mrs _____. My name is _____. I work for the Heart Health Program of the Montreal General Hospital. We are conducting a survey in your area as part of a community-wide heart disease prevention program. We recently sent a letter to your household about this project. **Did you see the letter?**

1 Yes 2 No

(As mentioned in the letter) the purpose of this survey is to learn more about your neighbourhood in order to discover more effective ways of preventing heart disease. The interview therefore includes questions about eating habits, physical activity and use of tobacco.

Your participation is extremely valuable and will ultimately help improve the health of people in your community. All the information which you provide is strictly confidential. The interview will take about 25 minutes. I'd like to begin with some general questions about your health.

Répondant choisi comme sujet. Je vous remercie d'avance pour votre collaboration. Votre participation est extrêmement importante et toute information de l'enquête est strictement confidentielle. Mes questions prendront environ 25 minutes. Commençons avec quelques questions générales sur votre santé.

Personne autre que répondant choisi comme répondant. Bonjour monsieur/madame. Je m'appelle _____. Je travaille pour le programme Coeur en santé qui est un projet de l'Hôpital général de Montréal. Nous faisons actuellement une enquête dans votre quartier qui fait partie d'un programme communautaire de prévention des maladies du coeur. Nous avons récemment envoyé, à votre ménage, une lettre expliquant ce projet. **L'avez-vous vue?**

1 Oui 2 Non

(Tel qu'indiqué dans la lettre), le but de cette enquête est de mieux connaître votre quartier afin de découvrir des moyens efficaces pour améliorer la santé du coeur. Nous allons donc poser des questions sur les habitudes alimentaires, l'activité physique et le tabagisme.

Votre aide est extrêmement importante et contribuera ultérieurement à l'amélioration de la santé du coeur des gens dans votre quartier. Toute information de l'enquête est strictement confidentielle. Mes questions prendront environ 25 minutes. On commence avec quelques questions générales sur votre santé.

GENERAL HEALTH QUESTIONS

1. **In general, compared to other persons your age would you say your health is...**

   1 Excellent
   2 Good
   3 Average
   4 Poor
   5 Very poor

2. **What are the most important things you have done in the past year to improve your health?** (Mark all that apply)

   1 Nothing

   1 Increased physical activity/exercise

   1 Lost weight

   1 Improved eating habits

   1 Quit smoking

   1 Reduced amount smoked

   1 Reduced drug/medication use

   1 Drank less alcohol

   1 Had blood pressure checked

   1 Attempted to control blood pressure

   1 Learned to manage stress

   1 Reduced stress level

   1 Received medical treatment

   1 Other (specify) _____

3. **Do you think about heart disease...**

   1 Often
   2 Sometimes
   3 Rarely
   4 Never

4. **Has a doctor ever told you that you have a problem with your heart such as angina, heart attack, myocardial infarction or heart failure?**

   1 Yes
   2 No
   7 Don't know

5. **Has a doctor ever told you that you have had a stroke?**

1 Yes
2 No
7 Don't know

6. **Are you diabetic?**

1 Yes
2 No → ♀ **>50 years Go to 9**
7 Don't know → ♂ **Go to 9**

7. **What age were you at the time of the diagnosis?**

_____years → ♀ **>50 years Go to 9**
♂ **Go to 9**
77 Don't know →

For women ≤50 years only

8. **Are you now pregnant?**

1 Yes
2 No
7 Don't know

9. **Has a doctor or nurse ever told you that you have high blood pressure?**

1 Yes
2 No → **Go to 11**

10. **In the past two days, did you take any medication to lower your blood pressure?**

1 Yes
2 No

11. **When did you last have your blood pressure checked?**

1 Less than 12 months
2 1-2 years
3 More than 2 years
4 Never → **Go to 13**
7 Don't know → **Go to 13**

12. **At that time, what was your blood pressure in numbers?**

☐☐☐/☐☐☐ mmHg

777/777 Don't know

13. **(Apart from taking medication) Are you currently doing anything to control your blood pressure?**

1 Yes
2 No → **Go to 15**

14. **What are you doing to control your blood pressure?** (Mark all that apply)

1 Decrease salt intake

1 Watch diet/modify diet

1 Physical activity/exercise

1 Rest and relaxation

1 Reduce alcohol use

1 Weight loss

1 Quit smoking

1 Other (specify) _____

15. **Has a doctor or nurse ever told you that you have high cholesterol?**

1 Yes
2 No → **Go to 17**

16. **In the past two days, did you take any medication to lower your cholesterol?**

1 **Yes**
2 **No**

17. **When did you last have your cholesterol checked?**

1 Less than 12 months
2 1-2 years
3 More than 2 years
4 Never → **Go to 19**
7 Don't know → **Go to 19**

18. **At that time, what was your cholesterol level <u>in numbers?</u>**

☐☐☐ mg/dl OR ☐.☐ mmol/L

777 Don't know

19. **(Apart from taking medication) Are you currently doing anything to control your cholesterol?**

1 Yes
2 No → **Go to 21**

20. **What are you doing to control your cholesterol?** (Mark all that apply)

1 Reduce fat

1 Other diet change

1 Physical activity/exercise

1 Weight loss

1 Other (specify) _____

21. **Over the last three months, did you read, watch or listen to anything about...**

Yes	No		(If yes, specify medium)
1	2	Heart disease	_____
1	2	Cholesterol	_____
1	2	Tobacco	_____
1	2	Physical activity	_____
1	2	Healthy eating	_____
1	2	Hypertension	_____
1	2	Weight control	_____

THE NEXT QUESTIONS ARE ABOUT PHYSICAL ACTIVITY.

22. **Are you limited in the kind or amount of physical activity or exercise you can do because of a physical condition or health problem?**

1 Yes
2 No → **Go to 25**

23. Are you limited because of a...

1 Temporary illness
2 Long-term illness
3 Temporary injury
4 Permanent injury or handicap

24. Are you completely unable to do any exercise or physical activity?

1 Yes → **Go to 48**
2 No

25. Would you say that you are physically more active, as active or less active than other persons your age?

1 More active
2 As active
3 Less active
7 Don't know

26.

27. Think about your usual pattern of participation in leisure time physical activity. Do you participate in leisure time physical activity...

1 Frequently
2 Occasionally
3 Infrequently
4 NEVER → GO TO 31

28. Do you usually participate in leisure time physical activity...

1 More frequently in winter
2 More frequently in summer
3 Same in winter and summer

29. With whom do you usually do physical activities in your leisure time? (Mark all that apply)

1 No one
1 Friends
1 Family members
1 Co-workers
1 Classmates at school
1 Other (specify) _____

30. **Where do you usually do your leisure time physical activities?** (Mark all that apply)

1 Home
1 Park
1 Recreation facility
1 Work
1 Commercial facility or private club
1 Outside (no special facility)
1 School, college, university facility
1 Other (specify) _____

31. **Over the last 12 months, would you say that your participation in leisure time physical activity has...**

1 Increased
2 Remained the same - inactive
3 Remained the same - active
4 Decreased
7 Don't know

32. **Of the people you see socially, how many engage in regular physical activity...**

1 None
2 A few
3 About half
4 Most or all
7 Don't know

33. **Now, think back over the past three months. <u>In a typical week</u>, how many hours do you spend in vigorous leisure time physical activity which causes you to perspire and to breathe hard?**

1 _____ Hours per day OR

2 _____ Hours per week OR

887 Less than one hour per week
000 Never → **Go to 36**
777 Don't know → **Go to 36**

34. **About how much time do you usually spend in vigorous leisure time activity (which causesyou to perspire and breathe hard) <u>on each occasion</u>?**

1 15 minutes or less
2 16 - 30 minutes
3 31 - 45 minutes
4 46 - 60 minutes
5 More than one hour
7 Don't know

35. **What are these activities (which cause you to perspire and to breathe hard)?** (Code up to 5 responses)

1. _____
2. _____
3. _____
4. _____
5. _____

36. **In a typical week, how many hours do you spend in moderate leisure time physical activity, such as brisk walking, bicycling or heavy gardening?**

1 _____ Hours per day OR

2 _____ Hours per week

887 Less than one hour per week
000 Never → **Go to 38**
777 Don't know → **Go to 38**

37. **About how much time do you usually spend in moderate leisure time activities on each occasion?**

1 15 minutes or less
2 16 - 30 minutes
3 31 - 45 minutes
4 46 - 60 minutes
5 More than one hour
7 Don't know

38. **In a typical week, how many hours do you spend in moderate to vigorous work-related physical activity such as heavy housework, construction work or physical labour?**

1 _____ Hours per day OR

2 _____ Hours per week

887 Less than one hour per week
000 Never → **Go to 40**
777 Don't know → **Go to 40**

39. **About how much time do you usually spend in moderate to vigorous work-related physical activity on each occasion?**

1 15 minutes or less
2 16 - 30 minutes
3 31 - 45 minutes
4 46 - 60 minutes
5 More than one hour
7 Don't know

40. Which of the following best describes your general level of physical effort in your work and daily activities...

1 Light -- such as office work, driving, sitting...
2 Moderate -- such as carpentry, walking, housework...
3 Heavy -- such as pushing or carrying heavy objects...
7 Don't know

41. Is there anyone who is encouraging you to be physically active?

1 Yes
2 No → **Go to 44**

42. Who is encouraging you to be physically active? (Mark all that apply)

1 Spouse

1 Children

1 Mother/father

1 Other family member

1 Friend

1 Other (specify) _____

43. Do you find this encouragement helpful?

1 Yes
2 No
7 Don't know

44. Are the following very, somewhat or not at all important in preventing you from being more physically active....

	Very important	Somewhat important	Not at all important
Lack of time	1	2	3
Lack of energy, too tired	1	2	3
Lack of athletic ability	1	2	3
Lack of programs or accessible facilities	1	2	3
Lack of a partner	1	2	3
Lack of support from family or friends	1	2	3
Lack of babysitting services	1	2	3
Cost	1	2	3
Lack of self-discipline	1	2	3
Self-conscious	1	2	3
Fear of injury	1	2	3

45.

46. **During the last year, did you use any of the centres for physical activity <u>in your neighbourhood</u> (for exercising)?**

1 Yes
2 No → **Go to 48**

47. **Which ones?** (Mark all that apply)

1 YMCA

1 Piscine St. Henri

1 Club de musculation (Les géants de Montréal)

1 Centre de loisirs Gadbois

1 Other (specify) _____

THE NEXT QUESTIONS ARE ABOUT TOBACCO

48. **Have you ever smoked cigarettes daily?**

1 Yes
2 No → **Go to 68**

49. **At what age did you start smoking cigarettes daily?**

_____ Years

77 Don't know

50. **Have you quit smoking permanently?**

1 Yes
2 No → **Go to 54**

FOR EX-SMOKERS ONLY

51. **How long has it been since you quit smoking?**

1_____ Number of weeks OR

2_____ Number of months OR

3_____ Number of years

77 Don't know

52. **How many serious attempts did you make before finally quitting?** (Do not count the last time when the subject quit permanently)

_____ Attempt(s)

77 Don't know

53. **The last time, when you finally quit, did you do it alone or with help such as self-help materials, nicotine gum, smoking cessation courses, hypnosis or acupuncture?**

1 Alone

2 With help (specify kind of help) _____

GO TO 68

SMOKERS ONLY

54. **Have you smoked any cigarettes during the last seven days?**

1 Yes
2 No → **Go to 57**

55. **Do you smoke cigarettes every day?**

1 Yes
2 No → **Go to 57**

56. **About how many cigarettes do you smoke each day?**

_____ Cigarettes per day OR

_____ Packs per day

57. **Have you ever tried to quit smoking?**

1 Yes
2 No → **Go to 61**

58. How many serious attempts have you made to quit smoking?

_____ Attempt(s)

77 Don't know

59. When was the last time you tried to quit?

1 _____ Number of weeks OR
2 _____ Number of months OR
3 _____ Number of years

777 Don't know

60. The last time you attempted to quit, did you do it alone or with help such as self-help materials, nicotine gum, smoking cessation courses, hypnosis or acupuncture?

1 Alone

2 With help (specify kind of help) _____

61. Are there any smoking cessation courses, support groups or other resources to help smokers quit in your neighbourhood?

1 Yes
2 No → **Go to 64**
7 Don't know → **Go to 64**

62. What are they? _____

_____

_____

63. Do you think that...

	Yes	No	Don't know
There are enough resources to help smokers quit in your neighbourhood	1	2	7
They are too far from where you live	1	2	7
They are available at hours convenient to you	1	2	7
They are too expensive	1	2	7

64. Is there anyone who is encouraging you to quit smoking?

1 Yes
2 No → **Go to 66**

65. Who is encouraging you to quit smoking? (Mark all that apply)

1 Spouse

1 Children

1 Mother/father

1 Other family member

1 Friend

1 Other (specify) _____

66. Tell me if, for you, the following would be easy, somewhat difficult or very difficult...

	Easy	Somewhat difficult	Very difficult
To smoke half of what you now smoke	1	2	3
To go all day without smoking	1	2	3
To quit entirely	1	2	3
To avoid situations in which you are tempted to smoke	1	2	3

67. Do you agree or disagree with the following...

	Agree (Yes)	Disagree (No)
I don't like my clothes to smell of cigarettes	1	2
I would rather continue smoking than risk gaining weight by quitting	1	2
Quitting would take away one of my real enjoyments in life	1	2

SMOKERS AND NONSMOKERS

68. How many persons in your household (including yourself) smoke cigarettes?

_____Persons

69. Of the people you see socially, how many smoke cigarettes...

1 None
2 A few
3 About half
4 Most or all
7 Don't know

70. **Do you ask others to stop smoking in your presence...**

1 Often
2 Sometimes
3 Rarely
4 Never

THE NEXT QUESTIONS ARE ABOUT YOUR EATING HABITS

71. **In general, compared to other people, would you say your eating habits are...**

1 Excellent
2 Good
3 Average
4 Poor
5 Very poor
7 Don't know

72. **Now please think about what you eat. In the last three months, did you eat the following foods often, sometimes, rarely or never...**

	Always/ Often	Some-times	Rarely/ Never	OR	Frequency
Broiled, baked or poached fish	1	2	3		_____
Fried fish or fishsticks	1	2	3		_____
Broiled or baked chicken	1	2	3		_____
Fried chicken	1	2	3		_____
Chicken without the skin	1	2	3		_____
Red meat with all visible fat trimmed	1	2	3		_____
Extra lean ground beef (hamburger)	1	2	3		_____
Hot dogs, salami, bologna, or other processed meats	1	2	3		_____
Bacon or sausages	1	2	3		_____
Spaghetti or noodles with meat, butter or cheese sauce	1	2	3		_____
Spaghetti or noodles with a tomatoe (nonmeat) sauce	1	2	3		_____
A vegetarian dinner	1	2	3		_____
Cooked vegetables without butter or margarine	1	2	3		_____
French fries or poutine	1	2	3		_____
Boiled or baked potatoes without butter or margarine	1	2	3		_____

	Always/ Often	Some-times	Rarely/ Never	OR	Frequency
Raw vegetables for snacks	1	2	3		_____
Green salad with no dressing	1	2	3		_____
Green salad with calorie-reduced dressing	1	2	3		_____
Fruit for dessert	1	2	3		_____
Fresh fruit for snacks	1	2	3		_____
Homogenized or whole milk	1	2	3		_____
2% milk	1	2	3		_____
Skim or 1% milk	1	2	3		_____
Low fat cheese or cheese made with partly skimmed milk	1	2	3		_____
Ice cream	1	2	3		_____
Low fat ice cream, frozen yoghurt, or sherbet	1	2	3		_____
Dessert with cream or whipped cream	1	2	3		_____
Bread, rolls or muffins without butter or margarine	1	2	3		_____
Donuts, cookies, cakes or pastries	1	2	3		_____
Chocolate or candy	1	2	3		_____
Snacks such as chips, fritoes, doritos	1	2	3		_____

73. Now I'd like to know about the way you prepare food. Over the last three months have you done the following often, sometimes, rarely or never...

	Always/ Often	Some-times	Rarely/ Never	Don't prepare food
Sauteed or pan fried food	1	2	3	4
Fried with Pam or other non-stick spray instead of oil, butter or margarine	1	2	3	4
Trimmed all the fat from red meat before cooking	1	2	3	4
Removed the skin from chicken before cooking	1	2	3	4
Used low fat mayonnaise	1	2	3	4
Added salt to food at the table	1	2	3	4
Read labels on bought foods	1	2	3	4

74. Is there anyone who is encouraging you to improve your eating habits?

1 Yes
2 No → **Go to 76**

75. Who is encouraging you to improve your eating habits? (Mark all that apply)

1 Spouse

1 Children

1 Mother/father

1 Other family member

1 Friend

1 Other (specify) _____

76. Are there any nutrition education courses, nutrition counselling services, dieteticians, or diet support groups in your neighbourhood?

1 Yes
2 No → **Go to 79**
7 Don't know → **Go to 79**

77. What are they? _____

_____

_____

78. Do you think that...

	Yes	No	Don't know
There are enough resources to help people eat better in your neighbourhood	1	2	7
They are too far from where you live	1	2	7
They are available at hours convenient to you	1	2	7
They are too expensive	1	2	7

THE NEXT FEW QUESTIONS ARE ABOUT YOUR OPINIONS

79. **Do you agree or disagree with the following...**

	Agree (Yes)	Disagree (No)
I would like to have more time for physical activity	1	2
I don't like to be out of breath and sweaty during physical activity	1	2
Part of what I like about physical activity is being with friends	1	2
The cost of the special equipment needed for exercise are worth it	1	2
I dislike spending my free time exercising	1	2
I don't like wearing the special clothes needed for exercise	1	2
For me, being physically active is a lot of fun	1	2
I don't like having to watch what I eat	1	2
I dislike food without salt	1	2
Eating healthy food is costly	1	2
Preparing healthy foods takes too much time	1	2
The people I live with would find it difficult to change the way they eat	1	2

80. **Tell me if, for you, the following would be easy, somewhat difficult or very difficult...**

	Easy	Somewhat difficult	Very difficult
To exercise even when you feel like doing something else	1	2	3
To organize yourself to exercise regularly	1	2	3
To try new kinds of physical activity	1	2	3
To not add salt to food at the table	1	2	3
To pass up junk food (chips, fritoes)	1	2	3
To buy only healthy foods	1	2	3

FINALLY, A FEW GENERAL QUESTIONS

81. **Apart from our letter, have you ever heard of the "Coeur en santé" project?**

1 Yes
2 No → **Go to 86**
7 Don't know → **Go to 86**

82. **When did you first hear about "Coeur en santé"?**

1_____ Number of weeks OR
2_____ Number of months OR
3_____ Number of years
777 Don't know

83. **How did you hear about Coeur en santé?** (Mark all that apply)

1 La Voix Populaire
1 La vente trottoir (sidewalk sale)
1 CLSC St-Henri/Little Burgundy
1 Community group (CEDA, Local Ensemble)
1 Other (specify)_____
1 Don't know

84. **Have you ever participated in any "Coeur en santé" activities?**

1 Yes
2 No → **Go to 86**

85. **Which activity(ies)?** _____
_____
_____
_____

86. Which of the following do you intend to do to improve your health in the next year...

Yes	No	Already do it	
1	2	3	Increase level of physical activity
1	2	3	Start a new physical activity
1	2	3	Eat a low fat diet
1	2	3	Reduce amount smoked
1	2	3	Quit smoking
1	2	3	Eat more fibre
1	2	3	Have blood pressure checked
1	2	3	Attempt to control blood pressure
1	2	3	Use less salt
1	2	3	Have cholesterol checked
1	2	3	Attempt to control cholesterol
1	2	3	Lose weight

87. Subject's sex

1 Male
2 Female

88. What is your date of birth?

_____ _____ _____
Day Month Year

89. How tall are you?

_____m_____cm OR _____feet _____inches

7/77 Don't know

90. How much do you weigh?

_____kg OR _____lbs

777 Don't know

91. How much would you like to weigh?

_____kg OR _____lbs

777 Don't know

92. What language do you speak at home most often?

1 French
2 English
3 French and English
4 Other (specify) _____

93. What is the highest grade or level of education you have ever com

01 Elementary

02 Some secondary
03 Completed secondary

04 Some CEGEP, technical school
05 Completed CEGEP, technical school

06 Some university, teacher's college
07 Completed university, teacher's college

08 Other educational training (specify) _____
77 Don't know

94. Which of the following best describes your main activity during the months...

1 Working at a job or business
2 Looking for work → **Go to 97**
3 A student → **Go to 97**
4 Retired → **Go to 97**
5 Keeping house → **Go to 97**
6 Other (specify) _____ → G

95. What kind of work do you do? (Provide as much detail as possible)

_____

_____

96. At work, do you have...

	Yes	No
Programs to improve health, physical fitness or nutrition	1	2
A total ban on smoking	1	2
Smoking restricted to designated areas	1	2

97. What is your current marital status?

1 Married (including common-law)
2 Single/never married
3 Separated
4 Divorced
5 Widowed

98. How long have you lived in your neighbourhood?

_____ Years

00 Less than 1 year

77 Don't know

99. What is your best estimate of the total income of all household members from all sources during the last 12 months? Was the total household income...

1 Less than 20 000 $

2 Less than 10 000 $

4 Less than 5 000 $

5 5 000 $ or more

3 10 000 $ or more

6 Less than 15 000 $

7 15 000 $ or more

8 More than 20 000 $

9 Less than 40 000 $

11 Less than 30 000 $

12 30 000 $ or more

10 40 000 $ or more

13 Less than 60 000 $

14 60 000 $ or more

15 No income

66 Refuse to respond

77 Don't know

100. This is the end of the questions. Thank you very much for your patience and your help. I want to let you know that my supervisor might call you in the next few days to check that I completed this interview.

Because we will repeat this survey in two years, **I would like to verify your home address and telephone number.** Interviewers: Verify subject's address and telephone number on household sticker on front page.

101. Are you planning to move?

1 Yes

2 No → **Go to 103**

Appendix IV

Additional information regarding study methodology

Table 1- Comparison of selected characteristics of subjects in St-Henri and the control community of Centre-Sud, who were retained in the longitudinal cohort sample survey (O'Loughlin et al. 1999).

	Community		
Characteristic	St. Henri	Centre Sud	p for difference
Respondents at baseline	849	825	N/A
Completed follow up	423	396	N/A
Moved/died	22	26	N/A
Refused	24	15	N/A
Unable to contact	380	388	N/A
Mean age, yr (SD)	38.6(12.4)	37.5(11.6)	0.169
Male, %	41.1	49.1	0.022
Completed high school, %	74.2	80.1	0.045
Insufficient household income, %	26.4	33.0	0.050
French spoken at home, %	66.3	81.7	0.001
No. Persons/household, mean (SD)	2.2 (1.2)	2.3 (1.3)	0.274

Table 2- Comparison of those who were retained in the longitudinal cohort and those who were lost to follow up (O'Loughlin et al. 1999).

Characteristic	Subjects retained in the cohort	Subjects lost to follow up	P for difference
Age, year (SD)	38.1 (12.0)	36.8 (12.5)	N/A
Male, %	45.0	54.9	0.001
Completed high school, %	73.2	77.0	0.074