

Social Cognitive Determinants of Exercise Intentions and Behaviour
in Patients with Coronary Artery Disease

By

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in Patients with Coronary Artery Disease**

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ABSTRACT

Coronary artery disease (CAD) remains to be the leading cause of death in developed countries. Exercise is a core factor in the secondary prevention of CAD, yet most patients diagnosed with CAD fail to meet exercise guidelines. Thus, new exercise interventions are required. Before interventions are developed, increased theory-based knowledge regarding modifiable exercise determinants is needed. The overall purpose of this dissertation was to examine the determinants of exercise intentions and behaviour over time in patients with CAD. More specifically, we tested a model based on social cognitive theory (SCT) in the prediction of exercise outcomes in two studies. First, in preparation for a larger cohort study, we conducted a cross-sectional pilot study that investigated which SCT variables appeared to be most strongly associated with the exercise intentions of 214 patients with CAD. Using structural equation modeling, results demonstrated that the model was a good representation of the relationships within the data. The SCT variables accounted for a large amount (54%) of the variance in exercise intentions in patients with heart disease. Intentions were influenced mainly by participants' self-efficacy and moderately by outcome expectations. Previous exercise, social support, and supportive physical environments also contributed to patients' intentions indirectly through self-efficacy and outcome expectations. Building from these results, the second study used a prospective longitudinal design to test a more comprehensive SCT model in the prediction of 770 cardiac patients' exercise behaviour at two time points. More precisely, we examined the relationships between previous exercise, physiological feedback, positive and negative social environments, supportive physical environments, self-efficacy, outcome expectations, exercise intentions and

exercise behaviour 6 months (time 1) and 12 months (time 2) after a CAD-hospitalization. Again, the model was a good fit to the data, and accounted for 22% and 34% of the variance in the participants' exercise behaviour at 6 and 12 months, respectively. Results indicated that previous exercise exerted the largest total effect on exercise behaviour at both time points, followed by self-efficacy. At time 1, supportive physical environments and exercise intentions also had significant direct links to exercise behaviour. At 12 months, participants' self-efficacy and outcome expectations predicted exercise behaviour directly. These studies provided support for the utility of SCT in the prediction of exercise outcomes in patients with CAD. Our findings also suggest ways to increase exercise behaviour in this population.

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CHAPTER 1 - INTRODUCTION

Cardiovascular diseases are a prevalent, growing and expensive problem. In fact, they are the leading cause of death worldwide (Mackay & Mensah, 2004). The financial costs associated with these diseases are upwards of \$18 billion a year in Canada (Health Canada, 2002) and are expected to exceed \$403 billion in the United States in 2006 (American Heart Association, 2006).

Coronary artery disease (CAD), the narrowing of the coronary arteries sufficiently to prevent adequate blood flow to the heart, is the most common form of cardiovascular disease (Mackay & Mensah, 2004; American Heart Association, 2006). Approximately 6% of the adult population in North America has established CAD and the prevalence is expected to rise as the population ages (American Heart Association, 2006; Heart & Stroke Foundation of Canada, 2003). CAD may lead to damage of the heart muscle due to lack of oxygenated blood (e.g., ischemia, infarction), and possibly death. Therefore, secondary prevention efforts are important in this population. Secondary prevention refers to modifying risk factors (e.g., sedentary living, hypertension) in patients already diagnosed with CAD in order to prevent further disease progression, recurrence of cardiac events, and death (Cardiac Care Network of Ontario, 2001).

Exercise and Coronary Artery Disease

Exercise is an integral behaviour in the secondary prevention of CAD and, therefore, an essential component in cardiac rehabilitation programs. Overall, cardiac rehabilitation programs are designed to enhance physical, psychosocial and vocational status of patients with heart disease. These multidisciplinary programs combine prescribed exercise with medical evaluation and intervention, education, psychological counselling, and behaviour modification (Cardiac Care Network on Ontario, 2001).

Although typically presented as part of the cardiac rehabilitation package, considerable evidence demonstrates the independent role of exercise in the secondary prevention of CAD (Myers, Prakash, Froelicher, Partington, & Atwood, 2002, Oldridge et al., 1998; Thompson, Buchner et al., 2003). In fact, in a review comparing exercise-only interventions to comprehensive cardiac rehabilitation, the effect of exercise-alone was stronger on a number of outcome variables (Jolliffe, Rees, Taylor, et al., 2001). Specifically, participants in exercise-only interventions had greater reductions in cholesterol, and all-cause and CAD mortality. Other studies have shown improvements in functional capacity (Myers et al., 2002), and positive psychological effects as a result of increased exercise (Engebretson, Clark, Niaura, et al., 1999; Oldridge, Gottlieb, Guyatt, et al., 1998).

As noted above, the morbidity and disability incurred as a result of CAD has economic implications as well. For example, Health Canada estimated an annual direct cost (i.e., physician services, medication) of treating CAD at \$2.33 billion with another \$128 billion being spent on home care, ambulances, and private-duty nurses. Some suggest that these costs may be curtailed by exercise. Researchers estimate that a 1% decrease in the number of inactive Canadians may reduce health care costs for CAD alone by approximately \$10 billion annually (Craig, Russell, Cameron, & Beaulieu, 1998). These findings have led to recommendations that individuals with CAD accumulate at least 30 minutes of moderate intensity exercise or greater (e.g., walking briskly, swimming) on most, if not all days of the week (American Heart Association, 2006; Heart and Stroke Foundation of Canada, 2006).

It remains unclear what proportion of the total CAD population meet the minimum criterion level of exercise and, subsequently, reduce further risk associated with the disease. Only 10-30% of eligible patients attend cardiac rehabilitation programs (Ades, 2001; Jolly et al.,

2003). Although less likely, it is possible that some individuals with heart disease exercise at sufficient levels independent of cardiac rehabilitation programs. However, research suggests that most sedentary individuals remain inactive without intervention (Marcus, Dubbert, Forsyth et al., 2000). In fact, a recent study showed that only 46% of patients with CAD were sufficiently active 12 months after a cardiac-related hospitalization (Reid et al., 2006). Therefore, new interventions are needed to promote exercise in this population. Exercise interventions should be designed to influence modifiable exercise determinants strongly associated with the behaviour. Before starting the intervention development process, increased knowledge regarding cardiac patients' exercise determinants is warranted.

Exercise Determinants

The majority of exercise determinants research has been conducted with healthy participants. In brief, numerous variables have been linked with exercise behaviour (Sallis & Owen, 1999; Trost, Owen, Bauman, Sallis, & Brown, 2002), including demographic (e.g., gender, age, ethnicity, socioeconomic status, education; Booth, Owen, Bauman, Clavisi, & Leslie, 2000; Brownson, Eyster, King et al., 2000), psychological (e.g., self-efficacy, outcome expectations, motivation, depression; Carlson, Norman, Feltz, et al., 2001; Lavie & Milani, 2001; Resnick et al., 2000; Senecal, Nouwen, & White, 2000), and environmental variables (e.g., social support, access to equipment, neighbourhood variables; Humpel, Owen & Leslie, 2002; King, Castro, Wilcox et al., 2000; McNeill, Wyrwich, Brownson, Clark & Kreuter, 2006).

Many unanswered questions remain regarding the determinants of exercise in diverse, non-healthy populations (Marcus et al., 2000). Considering their medical condition, individuals with CAD may have different reasons for adopting an exercise regimen as compared to their healthy counterparts (Orleans, 2000). For example, recommendations from one's physician may

motivate a person with CAD to be active, whereas fear of triggering a heart attack may deter others from exercising. To date, most of the studies investigating exercise determinants in this population have been conducted with convenience samples, that is, participants in structured cardiac rehabilitation programs. In these studies, self-efficacy has been the dominant variable studied. Results show a positive relationship with exercise behaviour (e.g., Blanchard, Rodgers, Courneya, Daub, Black, 2002; Carlson et al., 2001). Other research identified a positive attitude about exercise (e.g., beneficial or enjoyable), perceived behavioural control (e.g., a sense of control over their exercise), and subjective norm for exercise (e.g., people important to them approve of exercise) predicted exercise intentions and this, in turn, predicted adherence to the cardiac rehabilitation program regime (Blanchard, Courneya, Rodgers, Daub, Knapik, 2002). Studies have also investigated the influence of social support for exercise on cardiac patients' exercise behaviour, however, the findings have been mixed (Carlson et al., 2001; Moore et al., 2003). Overall, studies with cardiac rehabilitation participants have provided interesting information regarding exercise determinants; however, due to low rates of enrolment the representativeness of the findings is limited. More research examining the determinants of exercise in all CAD patients is needed.

Social Cognitive Theory

Criticism of previous studies lacking a sound theoretical framework (Dishman, 1994; Baranowski, Cullen, Nicklas, Thompson & Baranowski, 2003) has lead exercise researchers to apply health behaviour change theories to better understand exercise behaviour. These theories (e.g., Protection Motivation Theory, Theory of Planned Behaviour, Social Cognitive Theory) have been useful in exploring and identifying potentially important and modifiable exercise determinants (Baronowski et al., 2003). In addition, they offer a process to inform the

development and delivery of interventions and a guide for evaluating these interventions (ICEBeRG, 2006). Despite the benefit of theory-based investigations, few theoretically-driven studies exist that consider the predictors of exercise in patients with CAD (Blanchard, Courneya, et al., 2002; Plotnikoff & Higginbotham, 1998).

Social Cognitive Theory (SCT; Bandura, 1986) was the theoretical framework selected for the current research for numerous reasons. First, SCT is one of the most widely applied theories, both for physical activity determinants research and intervention development (Bauman, Sallis, Dzewaltowski, & Owen, 2002; Lewis, 2002). Second, this theory has demonstrated consistent empirical support and has contributed to our knowledge regarding exercise in the general population (Bauman et al., 2002; Trost et al., 2002; Conn, Burks, Pomeroy, Ulbrich & Cochran, 2003) and in some chronically-ill populations (Bennett, Mayfield, Norman, Lowe, & Morgan, 1999; Schwarzer & Fuchs, 1996). Specifically, variables from SCT have accounted for up to 60% of the variance in exercise behaviour in healthy adults (Conn, 1998; Rovniak, Anderson, Winett, Stephens, 2002). In addition, one of SCT's primary components, self-efficacy, has emerged as the most consistent correlate of exercise (Lewis, 2002; Trost et al., 2002), leading other theories to incorporate this variable. Third, unlike the other theories mentioned above, SCT takes into account physical environmental factors. This addition is essential as recent research demonstrates a link between variables in one's physical environment and exercise (Humpel et al., 2002; Trost et al., 2002). With this inclusion, SCT investigates intrapersonal, interpersonal, and environmental variables which may influence exercise behaviour and allows for a more complete understanding of exercise intentions and behaviour. Finally, SCT is also favourable because the core variables are dynamic and amenable to change, therefore, may be targeted in intervention programs (Young & King, 1995). In fact,

when variables from SCT are employed in intervention studies, participants increase their exercise behaviour (Pinto et al., 2001; Norris et al., 2000).

Social cognitive theory explains human behaviour in terms of a model of reciprocal determinism between the characteristics of the person, the environment, and the behaviour itself (see Figure 1; Bandura, 1986). As these variables constantly interact, a change in one component has implications on the others. Key SCT constructs that are said to influence behaviour include personal goals, self-efficacy, outcome expectations, and one's social and physical environment. As noted, these variables have been used successfully to inform exercise research in healthy adults, but apart from self-efficacy, SCT has been underutilized in the cardiac population. As a result, little is known about the relative importance of SCT constructs for exercise behaviour in patients with heart disease.

Personal Goals

Bandura (1986) argued that behaviour is regulated by setting and monitoring personal goals, and rewarding oneself if goals are attained. If goals are not met, individuals must problem-solve and alter their behaviour, or set new more realistic goals. Bandura (2004) noted that these personal and proximal (short-term) goals are essentially intentions that immediately precede and guide behaviour. Research has confirmed that intentions predict behaviour (Courneya, Keats & Turner, 2000; Rhodes, Courneya & Jones, 2003). In the cardiac domain, exercise intentions have been found to predict long-term adherence to an exercise program (Blanchard, Courneya, et al., 2002). The term intention is used in the remainder of this paper.

Self-efficacy and Outcome Expectations

According to SCT, the primary personal determinants of exercise intention and behaviour are self-efficacy and outcome expectations. Self-efficacy is proposed to be the most important

prerequisite skill for behavioural change (Bandura, 1997). It is defined as the “belief in one’s capabilities to organize and execute the course of action required to produce given levels of attainment” (Bandura, 1998, p.624), or simply said, one’s confidence to perform a specific behaviour. This is referred to as task self-efficacy (Blanchard, Rodgers et al., 2002). Thus, in the exercise domain, in order to alter a sedentary lifestyle people must believe they are capable of exercising at a certain frequency and/or intensity. A modest number of studies have examined this relationship in cardiac patients enrolled in cardiac rehabilitation programs and found that task self-efficacy predicted exercise adherence (Blanchard, Rodgers et al., 2002; Ewart, Taylor, Reese & Debusk, 1983; Robertson & Keller, 1992). In contrast, Jeng and Braun (1997) did not reveal a relationship between task self-efficacy and cardiac rehabilitation program compliance.

Barrier self-efficacy is an expansion of the original definition to include one’s confidence to overcome barriers that may impede the performance of the behaviour (i.e., Bandura, 1989). Therefore, to exercise one must believe he/she is not only capable of exercise but also of overcoming barriers that impede participation (Bandura, 1997). For example, people may think they have the skills to exercise regularly, however, when they are under pressure from work or feeling depressed, they may be less confident in their ability to adhere to an exercise program. In this line of thought, barriers to exercise may hamper one’s task self-efficacy and, therefore, should be an integral part of self-efficacy assessments (Bandura, 1995; 1998). This suggestion to measure barrier self-efficacy has been followed in an abundance of research. Indeed, it is used more frequently than task self-efficacy in the exercise literature (Sallis & Owen, 1999) and has been found to be the strongest and most consistent predictor of exercise behaviour (Sallis and Owen, 1999; Trost et al., 2002). To simplify, barrier self-efficacy is referred to as “self-efficacy” throughout the remainder of the paper.

Support for self-efficacy's role in the exercise arena has been obtained in numerous studies with healthy individuals (Booth et al., 2000; McAuley, Jerome, Elavsky, Marquez, & Ramsey, 2003; Resnick, 2001b) and patients in cardiac rehabilitation programs (Bennett, et al., 1999; Blanchard, Rodgers et al., 2002; Vidmar & Robinson, 1994). In addition, self-efficacy has predicted stage of change in exercise behaviour in cardiac patients (Hellman, 1997). The transtheoretical model of stages of change proposes that exercise is characterized as a process involving five distinct stages representing intentions and behaviours (i.e., precontemplation, contemplation, preparation, action, and maintenance; Prochaska & Velicer, 1997). In Hellman's study, reported self-efficacy was significantly higher for participants in more active stages (i.e., action or maintenance) than in stages comprised of inactive individuals.

Although less commonly studied than self-efficacy, outcome expectations – the belief that positive outcomes occur in response to behaviour – have been called the primary motivational variable in SCT (Bandura, 1998; Baronowski et al., 2003). Exercise-related outcome expectations include physical and psychological effects, social consequences, and internal self-rewards (Dzewaltowski, 1994). For example, cardiac patients may expect to reduce their risk of future disease and increase quality of life by exercising. Empirical results regarding the role of outcome expectations have been equivocal. One study found an strong independent link with exercise (Resnick, 2001a), whereas others have shown slight or modest associations with exercise (Bennett et al., 1999; Brown & Conn, 1995; Conn, 1997). The predictive power of outcome expectations remains unclear and warrants further study.

Self-efficacy is also said to shape outcome expectations such that if a person has high self-efficacy, they are more likely to expect positive outcomes from exercise (Bandura, 1997). For example, an individual may believe that exercise will produce a certain outcome (e.g.,

lowered blood pressure), yet if they do not feel capable of exercise on a regular basis, they will likely remain inactive (Bandura, 1997). Two studies supported this theoretical claim (Resnick et al., 2000; Rovniak et al., 2002). Specifically, one study with college students (Rovniak et al., 2002) and another with older adults (Resnick et al., 2000) found that exercise self-efficacy influenced outcome expectations. Further research would do well to examine this relationship.

It should be noted that both self-efficacy and outcome expectations reflect a person's beliefs, not actual capabilities (Clark & Becker, 1998). Moreover, self-efficacy and outcome expectations are not global traits or beliefs that operate independently from contextual factors. Instead, these constructs relate to beliefs about specific behaviours in specific situations and may vary depending on the behaviour and the context in which it occurs. Therefore, measurement must be specific to the target behaviour (exercise) and population (cardiac patients).

Sources of Self-efficacy and Outcome Expectations

Personal factors. SCT highlights important sources of information which influence self-efficacy and outcome expectations (see Figure 2). Previous experience and physiological feedback (emotional or physical responses to exercise) are two personal factors said to affect efficacy beliefs and expectations (Bandura, 1986). In fact, the successful performance of a behaviour is theoretically the strongest source of self-efficacy and outcome expectations (Bandura, 1986; Baranowski et al., 2002). In the exercise domain, SCT suggests that engaging in past exercise enhances one's confidence to re-engage in activity (e.g., "I've done it before, I can do it again") and increases one's expectations of the positive benefits of exercise (e.g., "I lost weight when I exercised before, I will likely lose again"). Surprisingly, research studies often fail to investigate the influence of previous exercise on self-efficacy and outcome expectations. Of the existing studies, claims of a positive relationship between previous exercise and self-efficacy

have been supported (Hagger, Chatzisarantis & Biddle, 2001; McAuley et al., 2003), whereas the link with outcome expectations has received less support (Conn, 1998; Rovniak et al., 2002). More research including this theoretically important variable is needed to clarify its role on self-efficacy and outcome expectations.

As noted, physiological feedback such as pain and fatigue is the other personal factor said to influence self-efficacy beliefs and outcome expectations (Bandura, 1986; Baranowski et al., 2002). Bandura claims that physiological indicators play an important role in exercise efficacy and expectations, especially in those of compromised health (Bandura, 1997). For example, when patients with CAD experience somatic symptoms (e.g., angina, shortness of breath) they may feel incapable of exercising and, therefore, have low confidence and expect little benefit from participating. Few empirical attempts have examined these relationships. Resnick and colleagues (2000; 2001a) found that good physical health significantly predicted self-efficacy, but not outcome expectations, in older adults. Additional investigations examining the influence of physiological feedback on self-efficacy and outcome expectations are needed, especially with those of compromised health such as patients with heart disease.

Environmental Factors. Bandura (1986) placed significant emphasis on personal dimensions, but also recognized the influence of the environment on self-efficacy and outcome expectations. Specifically, he noted that aspects of one's social environment such as verbal persuasion (i.e., encouragement from a credible source to engage in exercise) enhance these SCT beliefs. For example, information or encouragement from a physician or loved one may affect cardiac patients' expectations of the potential exercise benefits. Often, this concept is simply referred to as social support and has been measured as such (McAuley et al., 2003; Rovniak et al., 2002). Studies have found that exercise-related support by family and friends contributed to

increased exercise self-efficacy in the general population (McAuley et al., 2003; Rovniak et al., 2002). However, another recent study revealed that informational support (i.e., providing information about exercise) did not significantly predict exercise-related self-efficacy (McNeill et al., 2006).

Most studies regarding social environmental factors focus on social facilitators regarding exercise, but Bandura (1986) also spoke of environmental impediments. It is plausible that patients encounter negative social environments (i.e., environments that criticize or inhibit exercise behaviour) that hamper the development of self-efficacy and outcome expectations. For example, family members of cardiac patients who fear that exercise will cause further cardiac symptoms may communicate that the patient is incapable of exercise. Concerned loved ones may also focus the patients on the risks rather than the benefits of activity, reducing positive outcome expectations. Supporting this hypothesis, Coyle and Smith (1991) found that partners of cardiac patients discouraged exercise due to the fear of inducing future cardiac problems, but the researchers did not measure this impact on self-efficacy or outcome expectations. In fact, no published studies investigating the impact of negative social environmental variables on self-efficacy and outcome expectations were identified. In order to fully understand the influence of the social environment on cardiac patients' self-efficacy and outcome expectations, more attention should be paid to examining both positive and negative social environments.

SCT also argues that supportive physical environments (i.e., environments in which exercise resources are present and available) enhance self-efficacy and outcome expectations (Baranowski et al., 2003). If patients perceive that exercise resources are available and convenient, their confidence in their ability to overcome obstacles to exercise rises as do perceived benefits. Little effort has been directed at examining the influence of physical

environmental variables on these SCT constructs. Again, no studies were found in the published literature. In summary, research examining social and physical environments might shed additional light on the sources of information for self-efficacy and outcome expectations.

Direct Relationships with Exercise

In addition to their indirect contributions via these self-efficacy and outcome expectations, previous exercise, positive and negative social environments, and a supportive physical environment are also directly linked to exercise behaviour. These associations have been evaluated at least to some degree in previous research and are summarized below.

First, a relationship between past exercise behaviour and current behaviour has been revealed in most studies (Conn, 1998; Jackson, Smith & Conner, 2003; McAuley et al., 2003; Resnick, 2001b). In fact, the association between past exercise and current exercise behaviour was similar to self-efficacy in one study (Resnick, 2001b) and stronger in another (Jackson et al., 2003). However, a recent investigation failed to reveal the past to present behaviour relationship (Stiggebout, Hopman-Rock, Crone, Lechner, van Mechelen, 2006).

Second, much of the research in the exercise domain has demonstrated a positive link between positive social environments and exercise intentions and behaviour (Booth et al., 2000; Chogahara, 1999; Courneya, Plotnikoff, Hotz, & Birdett, 2000; Wallace, 2000). For example, an international study of six European countries identified a positive social environment as the strongest independent predictor of exercise (Stahl, Rutten, Nutbam et al., 2001). Specific to patients with CAD, Moore and colleagues (2003) established a link between social support for exercise and exercise frequency and persistence in cardiac rehabilitation. Yet, other cardiac researchers have found the opposite results (Allison & Keller, 1999; Carlson et al., 2001).

In contrast, a negative social environment has been found to be inversely related to exercise (Chogahara, 1999). Specifically, the study revealed that negative statements by participants' physicians were associated with lower levels of activity. Similarly, physician counter-indication prevents patients with heart disease from being active (Godin, Desharnais, Valoios, et al., 1994; Swan & Hillis, 2000). Further, patients with non-supporting spouses were three times more likely to drop out of structured rehabilitation programs, than patients with supportive spouses (Andrew, Oldridge, Parker et al., 1991). However, Booth and colleagues (2000) discovered that neither criticism nor upset from family and friends regarding exercise differentiated active versus inactive older adults. Understanding the interactions between family members, friends, and physicians and patients with heart disease may add to the determinants literature and could be helpful in developing future exercise interventions.

Finally, a supportive physical environment that provides easy access to exercise facilities or home equipment is a relatively new factor of interest in the exercise determinants literature (Trost et al., 2002). To date, existing data suggests a positive correlation with exercise (Booth et al., 2000; Jakicic, Wing, Butler, et al., 1997; King et al., 2000). For example, active individuals are more likely to report access to footpaths, parks, golf courses, recreation centres, or swimming pools in their neighbourhood (Booth et al., 2000; MacDougall, Cooke, Owen, & Willson, 1997). Factors in the physical environment such as access to facilities may be more influential for patients with CAD than the general population. For example, health concerns may prevent patients from engaging in exercise except when at cardiac rehabilitation programs. Convenient access to cardiac rehabilitation programs may entice individuals to exercise whereas lack of access to such programs may prevent activity. However, no studies focusing on environmental

variables in the cardiac population were found. Clarifying associations between the physical environment and exercise behaviour in cardiac patients warrants study.

Exercise Determinants Over Time

Approximately half of individuals who start exercising stop again within 3-6 months (Dishman, 1994). Like healthy individuals, 25-50% of participants in cardiac rehabilitation programs dropout within six months and at least 50% dropout within one year (Burke, Dunbar-Jacob, & Hill, 1997; Oldridge, 1991). Considering that regular sustained exercise is necessary for patients to attain optimal health and prevent further cardiac risk, maintenance of an exercise routine is essential. Despite this, many exercise determinant studies continue to use cross-sectional designs (Conn et al., 2003; McNeill et al., 2006; Blanchard, Rodgers et al., 2002; Blanchard, Courneya, et al., 2002). Further, when prospective designs are employed, few studies measure the variables of interest past 6 months post-enrolment (McAuley et al., 2003; Plotnikoff et al., 2001; Steptoe et al., 2000). It is not surprising, then, that prominent individuals in this field have suggested that in order to progress in exercise research investigators need to expand research endeavours to include the determinants of exercise over longer periods of time (Marcus et al., 2000; Sallis, 2001).

To date, longitudinal research has focused mainly on healthy individuals, leaving many unanswered questions regarding the determinants of exercise over time in chronically-ill populations such as individuals with CAD (Marcus et al., 2000). Two studies that measured cardiac patients' exercise behaviour at 6 months discovered that a positive social environment predicted behaviour (Carlson et al., 2001; King et al., 2001), and only one of these recruited individuals outside of cardiac rehabilitation programs (King et al., 2001). Considering low

enrolment rates in cardiac rehabilitation programs, attrition rates, and limited follow-up periods, important variables for understanding exercise over time in cardiac patients are likely missed.

Social cognitive theory's concept of reciprocal determination posits that the characteristics of the person, environment, and behaviour interact and, therefore, are constantly changing. This suggests that SCT variables could change over time. For example, as people become active, their self-efficacy may increase as their skills improve and they find solutions to obstacles encountered. Further, they may receive support from others in their social environment which, in turn, reinforces their exercise behaviour. Although the levels of the SCT variables may change, the relationships between them are expected to remain constant. However, previous research has revealed that factors predicting exercise adoption may be different from those predicting maintenance and, therefore should be studied as a separate entity (Bock, Marcus, Pinto & Forsyth, 2001; Sallis, Hovell, Hofstetter & Barrington, 1992). The authors of one study suggest that exercise after cardiac rehabilitation is influenced by outcome expectations acquired during the intervention (Bock et al., 2001). Examining SCT variables at different time points (e.g., immediately post-cardiac event versus 6 months later), may provide new information about which exercise determinants are most influential across time. Subsequently, more effective interventions could be designed and implemented for this group.

Purposes and Hypotheses

This dissertation is part of a larger multidisciplinary study investigating the trajectory of exercise behaviour in the two years post-cardiac hospitalization (i.e., baseline and 2, 6, 12, and 24 months). In addition, the larger study investigated multiple demographic, medical, psychosocial, and behavioural factors potentially involved in cardiac patients' exercise behaviour over this time period. The goal of the larger study was to use the information gathered over time

to develop an internet-based exercise intervention for patients with CAD. More specifically, psychosocial variables from numerous behaviour-change theories were included and their usefulness for influencing exercise behaviour was studied by various members of the research team.

The overall objective of this dissertation was to examine the determinants of exercise intentions and behaviour over time in individuals with CAD using SCT as a theoretical framework. Although the overall study aimed to collect data up to 24 months post-enrolment, only 12-month data was available at the time of the dissertation analyses. Specifically, a model based on SCT was tested to identify modifiable determinants of exercise intentions and behaviour. More precisely, associations between previous exercise, physiological feedback, social and physical environments, self-efficacy, outcome expectations and exercise intentions and behaviour were investigated. The model allowed for an examination of the relationships between the SCT variables as well as their predictive power on exercise intentions and behaviour. The general hypotheses that were tested within this dissertation are outlined below.

Hypotheses 1: Indirect Effects. Based on SCT, it was hypothesized that previous exercise, physiological feedback, and social and physical environments would influence exercise-related self-efficacy and outcome expectations. More precisely, we anticipated that more experience with exercise leads to greater confidence to exercise in the future as well as more benefits of engaging in the behaviour. Further, higher levels of social support for exercise and greater access to a larger number of exercise resources are expected to predict higher confidence to overcome barriers for exercise. In contrast, more frequent encounters with environments that have few exercise resources or that criticize/inhibit exercise behaviour are hypothesized to be associated with lower perceptions of exercise self-efficacy and outcome expectations. Similarly, we

expected that somatic symptoms such as shortness of breath would be predictive of lowered self-efficacy and outcome expectations. It is expected that each of these variables impact exercise behaviour indirectly through self-efficacy and outcome expectations. In addition, self-efficacy and outcome expectations are hypothesized to predict exercise intentions which, in turn, predict exercise behaviour. In line with SCT, this hypothesis predicts that people who have higher confidence in their abilities to perform physical exercises despite barriers and who have greater expectations of the potentially positive benefits of engaging in the activity have stronger intentions to be active. Therefore, self-efficacy and outcome expectations are expected to influence exercise behaviour, in part, through their influence on exercise intentions.

Hypotheses 2: Direct Effects. In addition to their indirect effects via self-efficacy and outcome expectations, previous research has shown that the previous exercise and social and physical environments have direct links to exercise behaviour. In this dissertation, previous exercise was hypothesized to be positively associated with higher levels of exercise behaviour over time. Although some mixed results have been reported, we also anticipated a positive relationship between the social environment (e.g., social support for exercise) and exercise behaviour. The reverse was expected for negative social environments. That is, greater levels of criticism or more frequent encouragement to avoid activity leads to lower levels of exercise. Studies with healthy adults lead us to predict that more enriched physical environments for exercise will lead to higher levels of behaviour. Similarly, we hypothesized that self-efficacy and outcome expectations would have a direct impact on exercise behaviour, in addition to the indirect effects noted above. Finally, as Bandura noted (2004), exercise intentions are the proximal determinant of behaviour and, therefore, are anticipated to be directly linked to exercise outcomes.

Hypotheses 3: Changes Over Time. Based on Bandura's concept of reciprocal determinism, we hypothesized that, although the levels of the variables would increase with experience, the relationships among the variables would remain constant over time. Therefore, the relationships described above in hypotheses 1 and 2 are expected to be observed in each test of the model.

The overall objective was divided into two studies that are presented in two separate articles in manuscript format. Also, additional testing of SCT's concept of reciprocal determinism is presented in a supplementary chapter.

In preparation for the larger cohort study, the first article presents results from our cross-sectional pilot study that investigated which SCT variables appeared to be most strongly associated with 214 cardiac patients' exercise intentions. Intentions, rather than behaviour, were employed as the outcome variable in this study because many patients had experienced a recent cardiac event and exercise levels could not be established at that time. Therefore, we tested a SCT model which included previous exercise, social support, a supportive physical environment, self-efficacy, outcome expectations, and exercise intentions as the outcome variable (see Figure 3). Specific hypotheses explored in this study include: 1) previous exercise would have a positive association with self-efficacy and outcome expectations; 2) social support for exercise and supportive physical environments would have both positive direct and indirect effects (via self-efficacy and outcome expectations) on exercise intentions; 3) self-efficacy and outcome expectations would positively and directly impact exercise intentions.

The second article presents the findings from the longitudinal cohort study of 801 patients with CAD. Expanding from the pilot study, we measured participants' exercise behaviour 6 and 12-months after a cardiac-related hospitalization. These time-points were

appropriate because exercise research tends to use a 6-month marker for adoption and maintenance. That is, a person may be considered active if exercising regularly, but to be classified as a long-term exerciser, people typically must be exercising for at least 6 months (Prochaska & Velicer, 1997). In addition, the self-report exercise measure asked patients to describe their activity level over the past 6-months. A smaller or larger time-frame would, therefore, not match the measurement instrument.

This study allowed for a more comprehensive examination of SCT variables related to exercise intentions and behaviour over time. In addition to variables in the first article, patients reported on physiological symptoms and negative social environmental variables. The aim of the second article was to explore additional sources of information for self-efficacy and outcome expectations, identify predictors of cardiac patients' exercise participation at 6 months and 12 months post-hospitalization, and to compare the significant predictors across these time points. Therefore, we tested the SCT model of exercise twice. At Time 1, variables measured at baseline (i.e., at hospital discharge) and 2 months post-hospitalization were used to predict exercise behaviour at 6 months. At Time 2, variables measured at 6 months post-hospitalization were used to predict 12-month exercise behaviour. The relationships between the variables were expected to be the same across time; therefore, the hypotheses were applied at both time-points (see Figure 4). The hypotheses for article 2 are identical to those presented above for the overall study.

Significance of the Studies

These studies advance exercise research on a number of levels. First, research on the determinants of exercise has mainly concentrated on healthy adults, neglecting individuals with chronic health problems. The present investigations addressed this gap by focusing on patients

with CAD. Moreover, of the studies with patients with heart disease, research has traditionally relied on convenience samples, that is, those enrolled in cardiac rehabilitation programs. Unfortunately, this sampling technique excludes up to 90% of the population (Ades, 2001; Jolly et al., 2003). The population in the present studies included a more representative and large sample of patients with CAD as recruitment was from hospital rather than cardiac rehabilitation programs. This approach provides a more representative picture of cardiac patients' experiences and determinants regarding exercise intentions and behaviour.

Second, the present studies were theory-driven, and the theoretical framework chosen (i.e., SCT) has shown strength and promise predicting exercise outcomes in previous studies. As such, researchers may formulate more advanced models of exercise and develop new interventions guided by theory. In addition, the majority of studies using SCT have concentrated on self-efficacy alone or few components of the theory. Our studies used a more comprehensive approach and incorporated numerous variables from SCT. This allowed for an examination of the theoretical relationships between the SCT variables. Specifically, the relationship between self-efficacy and outcome expectations, and the influence of previous exercise, physiological feedback and social and physical environments on self-efficacy and outcome expectations could be explored. Further, the explanatory power of SCT variables on exercise intentions and behaviour are revealed. Practically speaking, these variables may be used to design more effective interventions to change sedentary behaviour in the cardiac population.

Third, the majority of research regarding the social environment has focused on positive social environments (i.e., social support for exercise) ignoring the potential effects of a negative social environment on exercise. Due to their medical condition, this could be one of the

important impediments to which Bandura refers. The relationship between a negative social environment and exercise was investigated in the second article.

Fourth, this dissertation adds to the burgeoning research examining physical environmental variables in the exercise domain. There has been progress in this area in the last few years, yet, some results are inconsistent and much remains unknown. Therefore, investigations regarding physical environmental variables are a high priority for research (Trost et al., 2002). Further, of the published studies, most have surveyed the physical environment of healthy individuals (Leslie et al., 1999). Our studies expanded this area by exploring the physical environment of a chronically-ill population (i.e., patients with CAD) -- the first study of its kind.

Fifth, comparing exercise determinants over time has been limited by a paucity of studies examining exercise behaviour in the long-term (i.e., > 6 months). The longitudinal design in our second article allows for an investigation of variables up to one year post-hospitalization. Above and beyond cross-sectional studies, this design provides a better understanding of the specific variables that predict cardiac patients' exercise behaviour at various time points as well as map the natural history of exercise in cardiac patients. Variables identified as stronger predictors soon after a cardiac-related hospital admission versus months post-hospitalization provides new knowledge. In addition, this information may allow practitioners to tailor intervention efforts for each time point and enhance participants' success.

Finally, unlike past exercise research that has relied on correlational or multiple regression analyses (Masse, Dassa, Giles-Corti & Motl, 2002), we employed structural equation modeling to test our conceptual models. The advantage of this method is that parameter estimates of the relationships between the variables are corrected for measurement error. In addition, the estimates are conducted simultaneously enabling direct and indirect comparisons of

the relationships between the multiple variables (Masse et al., 2002). In fact, this method is considered to have more power than the mediating variable approach (Tabachnick & Fidell, 2007).

Organization of the Remainder of the Dissertation

The remainder of the dissertation is organized into four chapters. In the next chapter (chapter 2), the first journal article entitled “Testing a Social Cognitive Model of Exercise Intentions in Patients with Coronary Artery Disease” is presented. Chapter 3 included the journal article entitled “Personal and Environmental Determinants of Exercise in Patients with Coronary Artery Disease: Evaluating a Social-cognitive Model.” Both manuscripts have been prepared for submission to scientific journals, and they are formatted accordingly. Chapter 4 presents the results from additional analyses that further tested SCT’s concept of reciprocal determinism. In Chapter 5, the overall findings from both articles are discussed. Finally, the appendixes include the questionnaires employed in the pilot study (Appendix A) and longitudinal study (Appendix B).

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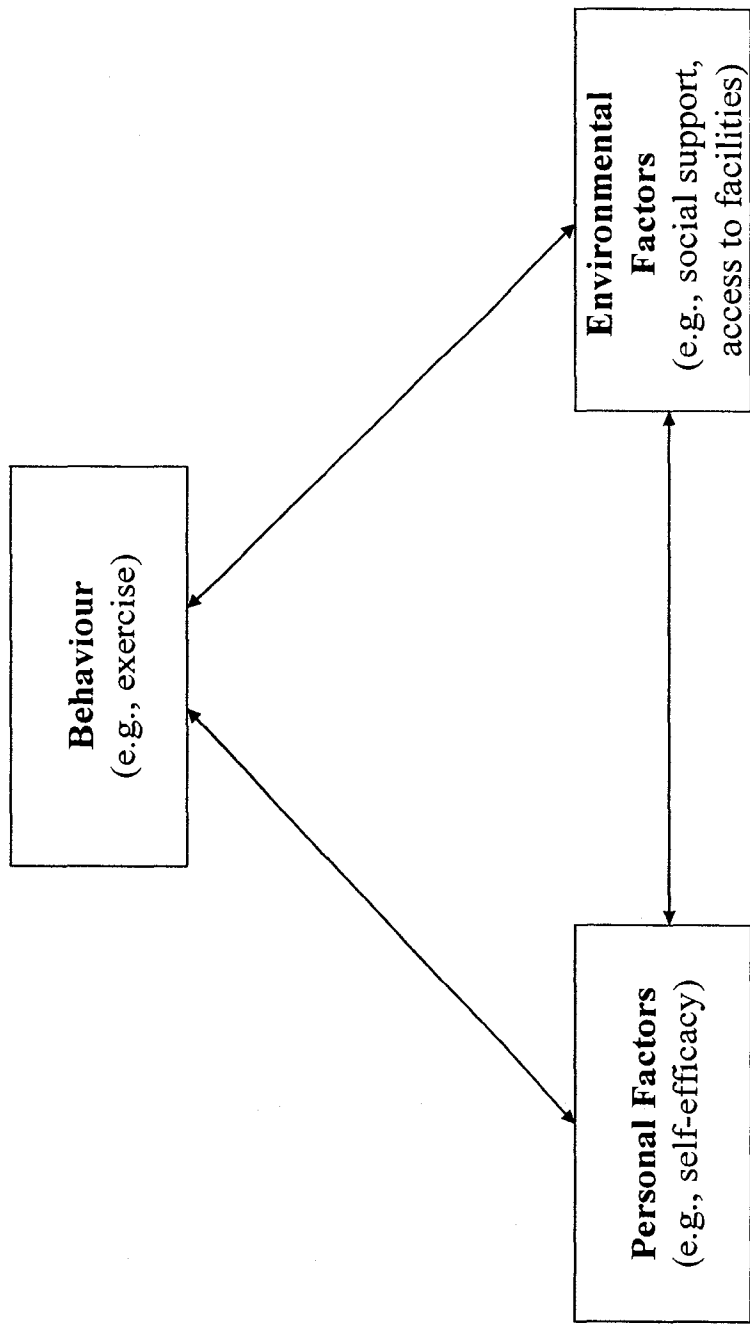


Figure 1. Social Cognitive Theory's Triad of Reciprocal Determination

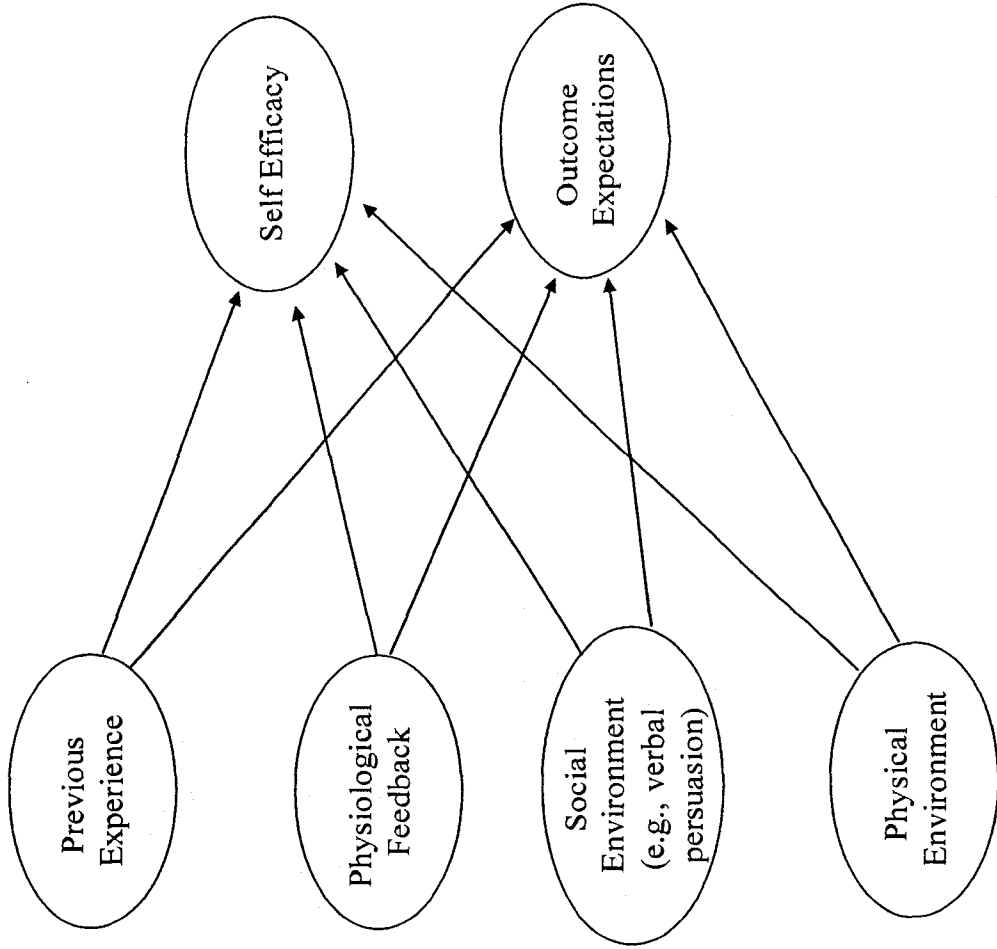


Figure 2. Sources of Information for Self-efficacy and Outcome Expectations

CHAPTER II

TESTING A SOCIAL COGNITIVE MODEL OF EXERCISE INTENTIONS IN PATIENTS
WITH CORONARY ARTERY DISEASE

Testing a Social Cognitive Model of Exercise Intentions
in Patients with Coronary Artery Disease

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ABSTRACT

Exercise is important for patients with coronary artery disease (CAD), yet many patients are insufficiently active to gain health benefits. New theoretically-based interventions are needed to promote exercise in this population. The present study aimed to identify social cognitive variables associated with cardiac patients' exercise intentions. Patients with CAD (N=214, 79% male, M age=64 years) completed questionnaires measuring previous exercise, self-efficacy, outcome expectations, social support, physical environment variables, and intentions. Structural equation modeling was used to test the model, and yielded a good fit. The variables accounted for 54% of the variance in participants' exercise intentions. Intentions were mainly influenced by participants' self-efficacy beliefs, and moderately by their outcome expectations. Previous exercise and social and physical environments operated primarily through self-efficacy and outcome expectations. The social cognitive variables studied proved their importance in the prediction of exercise intentions and warrant inclusion in the longitudinal cohort study and future interventions for cardiac patients.

Testing a Social Cognitive Model of Exercise Intentions in Patients with Coronary Artery Disease

INTRODUCTION

Regular exercise is important in the secondary prevention of coronary artery disease (CAD) because it may reduce disease progression and mortality, and improve quality of life in cardiac patients (Myers, Prakash, Froelicher, Partington & Atwood, 2002; Oldridge et al., 1998; Thompson et al., 2003). Evidence-based guidelines recommend that individuals with CAD accumulate a minimum of 30 minutes of exercise at a moderate intensity or greater on a daily basis (American Heart Association, 2006; Fletcher et al., 2001). Unfortunately, many cardiac patients are insufficiently active to gain health benefits. For example, one study found that only 27% of patients met exercise guidelines after cardiac rehabilitation (Bock, Carmona-Barros, Esler, & Tilkemeier, 2003). Therefore, new interventions are required to promote exercise in cardiac patients.

Interventions to promote exercise should be designed to influence modifiable factors strongly associated with the behaviour. Health behaviour change theories have been useful in exploring and identifying potentially important and modifiable exercise determinants (Baranowski, Cullen, Nicklas, Thompson & Baranowski, 2003). These theories also offer a process to inform the development and delivery of interventions, and a guide for evaluating interventions (ICEBeRG, 2006). Despite the benefit of theory-based investigations, few theoretically-driven studies exist that consider the predictors of exercise in cardiac patients (Blanchard, Courneya, Rodgers, Daub & Knapik, 2002; Plotnikoff & Higginbotham, 1998).

Social Cognitive Theory (SCT; Bandura, 1986) is one of the most widely applied theories, both for exercise determinants research and intervention development (Bauman, Sallis,

Dzewaltowski & Owen, 2002). This theory explains behaviour as a dynamic process that is influenced by personal attributes and environmental characteristics. More specifically, key SCT constructs include personal goals (or intentions), self-efficacy, outcome expectations, and one's social and physical environment. To date, these variables have been used successfully in the prediction of exercise in healthy adults (Bauman et al., 2002; Trost, Owen, Bauman, Sallis & Brown, 2002), but apart from self-efficacy, SCT has been underutilized in the cardiac population. As a result, little is known about the relative importance of SCT constructs for exercise behaviour in cardiac patients.

Bandura (2004) noted that personal and proximal goals are essentially intentions that immediately precede and guide behaviour. Research had supported this association between intentions and behaviour in healthy adults (Rhodes, Courneya & Jones, 2003; Plotnikoff & Higginbotham, 2002; Rodgers, Hall, Blanchard, McAuley, & Munroe, 2002). Specific to the cardiac domain, exercise intentions have been found to predict long-term adherence to an exercise program (Blanchard, Courneya et al., 2002).

According to SCT, the primary personal determinants of exercise intentions and behaviour are self-efficacy and outcome expectations. Self efficacy is defined as one's confidence to perform an activity under a variety of circumstances (Baranowski et al., 2003). Therefore, one must believe that he/she is not only capable of doing exercise (i.e., skills), but also overcoming barriers that impede exercise participation. Outcome expectations are beliefs that a positive outcome will occur from performing a behaviour (Bandura, 1986). For example, in the cardiac population, people may expect to reduce their risk of future disease by exercising.

Previous research has consistently demonstrated self-efficacy's role in predicting exercise intentions and behaviour in healthy and cardiac populations (Blanchard, Rodgers, Courneya,

Daub & Black, 2002; Booth, Owen, Bauman, Clavisi & Leslie, 2000; Trost et al., 2002; Woodgate, Brawley & Weston, 2005). In contrast, the role of outcome expectations is less apparent. Two studies demonstrated an independent link between outcome expectations and exercise (Conn, Burks, Pomeroy, Ulbrich, Cochran, 2003; Resnick, 2001a), whereas others have shown only modest contributions (Bennett, Mayfield, Norman, Lowe & Morgan, 1999; Rovniak, Andersom, Winnett & Stephens, 2002). As outcome expectations are a primary motivational factor in SCT (Baranowski et al., 2003), additional research is warranted. Moreover, few studies have investigated if self-efficacy shapes outcome expectations as postulated by SCT (Conn, 1998; Resnick, 2001b; Rovniak et al., 2002).

SCT highlights sources of information which influence self-efficacy and outcome expectations. These include previous performance of the activity and social and physical environmental variables (Bandura, 1986). Despite this theoretical claim, previous exercise is often ignored as a determinant of self-efficacy and outcome expectations. Of the existing studies, a positive relationship between self-efficacy and previous exercise has been supported (Hagger, Chatzisarantis & Biddle, 2001; McAuley, Jerome, Elavsky, Marquz, & Ramsey, 2003), whereas the link between previous exercise and outcome expectations continues to be unclear (Resnick, 2001a; Conn, 1998). The influence of the social environment on self-efficacy and outcome expectations has received more attention. Research has shown that the social environment, through concepts such as verbal persuasion (e.g., encouragement), enhances self-efficacy (McAuley et al., 2003; Rovniak et al., 2002). Little research has examined this relationship with cardiac patients, yet it is important to understand for intervention development. Finally, Bandura (1997) noted that self-efficacy rises as barriers to activity diminish. If participants perceive that exercise resources are available and convenient, they feel more confident in their ability to

overcome obstacles to exercise. Therefore, a supportive physical environment (environments in which exercise resources are available) should enhance self-efficacy beliefs. We were unable to identify any previously published studies examining this relationship. However, the inclusion of physical environmental variables is theoretically justified.

In addition to their indirect effects via self-efficacy and outcome expectations, recent research also shows a direct link between social and physical environmental variables and exercise intentions and behaviour (Booth et al., 2000; Courneya, Plotnikoff, Hotz, & Birkett., 2000; Humpel, Owen, Leslie, 2002; Okun, Karoly & Lutz, 2002). However, some conflicting data exist. Regarding the social environment, Moore and colleagues (2003) discovered a positive relationship between social support and exercise frequency and persistence in cardiac rehabilitation, whereas other researchers found the opposite result (Allison & Keller, 1999; Carlson et al., 2001). In fact, cardiac patients may be discouraged from exercise, as loved ones fear that such activity will cause further heart problems (Coyle & Smith, 1991). Similarly, existing data on the link between the physical environment and exercise has revealed a positive and direct correlation (Booth et al., 2000; Humpel et al., 2002); however, some results showed only small to modest associations (De Bourdeaudhuij, Sallis, & Saelens, 2003; Jakicic, Wing, Butler & Jeffrey, 1997). It is plausible that physical environmental factors, such as access to facilities, are more influential on cardiac patients than the general population. For example, health concerns (e.g., fear of triggering a heart attack) might prevent cardiac patients from engaging in exercise except when at a cardiac rehabilitation program. However, no published study has examined the role of the physical environment on exercise outcomes in cardiac patients. This is an important next step in exercise research. In summary, both the indirect and

direct paths from the environmental variables to exercise intentions warrant inclusion in the model.

The Present Study

To gain insight into modifiable determinants of exercise adoption and maintenance in patients with CAD, a longitudinal cohort study was planned. Due to the large number of potentially important determinants that could be studied (e.g., demographic, clinical, psychosocial), a preliminary cross-sectional study was conducted to identify key SCT constructs that should be included in the longitudinal study and subsequent intervention designs. Current exercise levels could not be established because many patients experienced a recent cardiac event. Therefore, we focused on the proximal determinant of behaviour – exercise intentions. Accordingly, the purpose of the present study was to identify which SCT variables appear to be most strongly associated with exercise intentions in cardiac patients. Specifically, we tested a SCT model which included relationships between previous exercise, social support, physical environmental variables, self-efficacy, outcome expectations, and exercise intentions as the outcome variable.

Figure 1 displays the proposed model and hypothesized relationships between the SCT variables and exercise intentions. The model predicted that previous exercise would be positively associated with self-efficacy and outcome expectations. Further, greater social support for exercise and supportive physical environments would have both direct and indirect effects (via self-efficacy and outcome expectations) on exercise intentions. That is, higher levels of social support and access to a larger number of exercise resources are expected to lead to stronger exercise intentions, as well as predict greater perceptions of self-efficacy and outcome expectations which, in turn, predict exercise intentions.

METHOD

Setting and Participants

A total of 214 patients with documented CAD were recruited from hospital admissions and cardiac rehabilitation classes at the University of Ottawa Heart Institute, a tertiary cardiac care facility in Canada. Patients were required to read in English and have no contraindications to exercise (e.g., uncontrolled cardiac arrhythmias, musculoskeletal or rheumatoid disorders). This study was approved by the Human Research Ethics Boards at the University of Ottawa Heart Institute. All participants provided written informed consent.

Procedures

Participants were recruited from hospital following a cardiac event (e.g., acute myocardial infarction, coronary artery bypass grafting) or from a cardiac rehabilitation program. The research coordinator approached individuals in hospital at the point of discharge or at a cardiac rehabilitation class. Patients engaged in a short interview (10 minutes) and completed the study questionnaires. The interview consisted of a brief medical history, demographic data and contact information. Questionnaires were completed on site and collected by the research coordinator or returned by mail.

Measures

Demographic information. Participants reported their age, sex, education level, income, ethnicity, and employment, marital and smoking status.

Previous exercise. Participants' exercise behaviour over the previous 6 months was assessed with the Godin Leisure-Time Exercise Questionnaire (GLTEQ; Godin & Shephard, 1985). Patients reported the frequency and intensity of exercise lasting at least 15 minutes. The GLTEQ yields a leisure activity score by summing the products of light, moderate, and strenuous

exercise and their respective metabolic equivalence value (i.e., 3, 5, 9, respectively). Scores above 24 are consistent with current exercise guidelines (N.Bertrand, G.Godin, 2004, personal communication). An independent evaluation of this instrument found it to be reliable and valid (Jacobs, Ainsworth, Hartman, & Leon, 1993).

Social support for exercise was assessed with 6 items developed by Sallis and colleagues (1992). On a 5-point scale (0 = never, 4 = very often), participants indicated the degree of support for exercise that they received from family and friends. An extra item was added by the researchers to measure the frequency that participants' health care provider encouraged them to exercise. Results showed this measure to be internally consistent ($\alpha = .82$).

Supportive physical environment. Three aspects of the physical environment were assessed: the neighbourhood, home exercise equipment, and access to exercise facilities in the community. Participants indicated if particular physical features or items were present in their neighbourhood (e.g., hills, traffic) or home (e.g., running shoes, treadmill), and if they had convenient access to facilities (e.g., bicycle paths, racquet courts). This questionnaire was modified from the original measures (Sallis et al., 1992) to include items for the winter season in Canada (e.g., skis, skating rink), and was found to be internally consistent ($\alpha = .79$).

Self-efficacy was assessed with 12 items compiled from previously validated questionnaires (Plotnikoff & Higginbotham, 2002; Jeng & Braun, 1997). Participants reported their confidence in their ability to do regular exercise (at least 30 minutes of moderate intensity exercise 4 or more days of the week) when presented with various obstacles (e.g., bad weather, feeling tired). Statements were rated on a 7-point scale ranging from "not at all confident" (1) to "completely confident" (7).

Given that the items were compiled from previous scales, the psychometric integrity of this scale was verified. The 12 items were subjected to a maximum likelihood analyses with varimax rotation. A one-component solution emerged accounting for 78% of the total solution variance. All items loaded strongly on the self-efficacy component (loadings ranged from .65-.91), and demonstrated high internal consistency ($\alpha = .96$). To establish construct validity, the scores from our self-efficacy scale were correlated with a previously validated measure – The Self-Efficacy Scale developed by Garcia and King (1991). There was a significant correlation between scales ($r = .69$). This level of correlation is desirable as it shows a significant relationship between the scale measuring the same construct, but not redundancy. The stability of the scale over time was assessed by the test-retest reliability correlation between baseline and follow-up scores reported 3-4 weeks later among a subsample of 43 participants. Correlations were significant for the overall mean score ($r = .65$, $p < .001$) and the individual items ($r = .48$ to $.66$, $ps < .001$).

Outcome expectations. Four subscales (i.e., psychological, body image/health, fun, social) from Steinhardt and Dishman's (1989) previously validated Outcome Expectancy Scale were used to assess participants' expectations regarding the benefits of exercise. Participants rated their agreement with 15 statements about possible exercise outcomes (e.g., improved mental alertness, fun and enjoyment, maintain or lose weight) on a 5-point scale ranging from strongly disagree (1) to strongly agree (5). Overall, this measure had good internal consistency ($\alpha = .94$), as did the four subscales ($\alpha = .79-.94$).

Exercise intentions were assessed with three items (Courneya & McAuley, 1993). Participants indicated the degree to which they intended to exercise regularly over the next month and next six months, on a 7-point scale from strong disagree to strongly agree.

Participants also reported the frequency (i.e., number of times per week) that they intended to exercise over the next six months. The three items demonstrated high internal consistency ($\alpha = .80$).

Data Analyses

The data was initially screened to verify that the statistical assumptions of normality, linearity, and homoscedasticity were met. Missing data was checked and found to encompass 5% of the overall data set. Missing data across the variables under study ranged from 1-8%. As the data was missing at random, unbiased estimates were imputed using the expectation maximization algorithm (Shafer & Graham, 2002). Preliminary analyses revealed no univariate skewness, kurtosis, or outliers for all measures. Seven cases (3%) presented significant Mahalanobis' distances ($p < .001$) indicating multivariate outliers. These cases were removed from further analyses, yielding a final sample size of 207 participants. Descriptive analyses were then performed to provide summary statistics on each of the variables under study. An assessment of the psychometric properties of the study measures was conducted. Next, correlations between exercise intentions and the demographic variables were completed.

The main analyses consisted of measurement and structural equation modeling procedures for the estimation of the hypothesized model of exercise intentions. Structural equation modeling was conducted using EQS 6.1 Structural Equations Program (Bentler & Wu, 2004). Estimation was performed using maximum likelihood (ML) fitting function (Bollen, 1989). For the purposes of identification, the loadings between the first indicator of each latent construct and its target factor were fixed to 1.0. A number of fit indexes were employed to evaluate the overall model fit. In line with the current state of practice and recommendations regarding written summaries of structural equation analyses (Kline, 2005), these included the

comparative fit index (CFI), goodness of fit index (GFI), root mean square error of approximation (RMSEA), standardized root mean square residual (SRMR), and model chi-square. Acceptable model fit is generally indicated when CFI and GFI values are greater than .90, and RMSEA and SRMR are less than .10 (Kline, 2005). The significance of the total and indirect effects were evaluated using the decomposition of effects function within EQS (Tabachnick & Fidell, 2007).

RESULTS

The descriptive characteristics of the study sample are displayed in Table 1. The majority of participants were Caucasian, male, non-smokers, retired, well-educated, of higher socioeconomic status, and married. On average, the cardiac patients reported insufficient activity levels in the last six months to gain health benefits ($GLTEQ = 18.6 \pm 16.2$). Fifty-one percent of participants were enrolled in cardiac rehabilitation.

Social Cognitive Variables

The scores for self-efficacy, outcome expectations, social support for exercise, and the physical environment are presented in Table 2. Overall, participants were fairly confident that they would be able to engage in regular exercise, despite various obstacles. Individual item means showed that participants felt the least confident to exercise when faced with bad weather ($M = 4.0 \pm 1.70$), and most confident to be active even when no improvements in health were noticed ($M = 5.08 \pm 1.47$). Participants reported moderate levels of agreement with the 15 possible outcomes expectations. An inspection of the subscales revealed that body image/health was given the highest endorsement.

On average, participants reported low levels of social support for exercise from all sources. When participants received social support, it was typically from family members and in

the form of encouragement to exercise ($M = 2.21 \pm 1.40$). Respondents also indicated that health care providers sometimes provided encouragement to exercise ($M = 2.08 \pm 1.31$).

Participants reported on three aspects of their physical environment: neighbourhood, home exercise equipment, and access to exercise facilities (Table 2). On average, participants indicated that they had access to 14 of the 31 possible exercise resources. The most common home exercise equipment was running shoes, and the most common exercise facility was a suitable area for walking.

Exercise Intentions

Overall, participants reported strong intentions for regular exercise over the next month (5.2 ± 1.97) and next 6 months (5.70 ± 1.59). On average, they intended to exercise four times per week (± 1.85).

Test of the Measurement Model

It is customary to assess the quality of the measurement instruments using confirmatory factor analyses (CFA) to confirm the factor structure of all model constructs before proceeding to the estimation of the full model. This approach allows for the systematic detection and correction of any measurement problem liable to interfere with the assessment of the structural model (Byrne, 2006). The overall fit of the measurement model was good ($\chi^2(80) = 152.92, p < .001$; CFI = .97; GFI = .91; RMSEA = .06; SRMR = .06). All factor loadings were significant at the .05 level. These values and their respective residuals (in parentheses) are displayed in Figure 2. Because the fit statistics from the measurement model indicated that the measures adequately represented each latent variable, we proceeded to tests of the structural model.

Test of the Hypothesized Model of Exercise Intentions

The resulting model of exercise intentions is presented in Figure 3. Model estimation yielded a good fit ($\chi^2(94) = 178.38, p < .001$; CFI = .96; GFI = .91; RMSEA = .06; SRMR = .08). The correlations between the latent variables and their internal consistencies are presented in Table 3.

Self-efficacy was predicted by social support for exercise, previous exercise, and a supportive physical environment. A moderate amount of variance in self-efficacy was explained by these three variables (18%). Similarly, 14% of the variance in participants' outcome expectations was accounted for by social support for exercise and previous exercise. Contrary to the hypothesis, the association between self-efficacy and outcome expectations was not significant. Exercise intentions were mainly influenced by participants' self-efficacy beliefs, and moderately by their outcome expectations. Social support for exercise and a supportive physical environment influenced exercise intentions indirectly through self-efficacy and outcome expectations, but a significant direct relationship was not revealed. Overall, variables in the model accounted for 54% of the explained variance in exercise intentions of patients with CAD.

The total effects of each latent variable were also examined. Self-efficacy was the most influential predictor of exercise intentions ($\beta = .45$), followed by social support ($\beta = .31$), outcome expectations ($\beta = .16$), and a supportive physical environment ($\beta = .11$).

DISCUSSION

The purpose of this study was to identify key SCT variables that predict exercise intentions in patients with CAD in order to inform a follow-up, prospective cohort study. Specifically, we tested a SCT model which included relationships between previous exercise, social support for exercise, physical environmental variables, self-efficacy, outcome

expectations, and exercise intentions. Overall, the indices of fit indicated that the structural model was a good representation of the relationships within the data. The SCT variables accounted for a large amount of the variance in cardiac patients' exercise intentions. This finding is equivalent to or larger than previous studies with healthy adults and cardiac patients that used variables from the theory of planned behaviour (Blanchard, Courneya et al., 2002; Jackson, Smith & Conner, 2003) and protection motivation theory (Plotnikoff & Higginbotham, 2002).

As expected, self-efficacy was found to be a central component in the prediction of exercise intentions. This finding indicates that cardiac patients who feel more confident in overcoming various obstacles for exercise have greater intentions to engage in activities. These results are in line with previous research (Blanchard et al., 2002; Rodgers et al., 2002) and core postulates of SCT. Outcome expectations also had a significant and direct impact on exercise intentions, although to a lesser degree than self-efficacy. This result is consistent with previous studies demonstrating the relatively weaker link between outcome expectations and exercise intentions in comparison to self-efficacy (Bennet et al., 1999; Conn, 1998). This finding helps clarify the role of outcome expectations in the SCT model. In addition, our study found an insignificant relationship between self-efficacy and outcome expectations. This result is contradictory to theory and previous studies demonstrating self-efficacy's impact on outcome expectations (Resnick, 2000; Rovniak et al., 2002). Further research is needed in order to support or dispel SCT's claim that self-efficacy shapes outcome expectations in the exercise domain.

Analysis of the hypothesized model offered strong support for the antecedents of exercise self-efficacy and outcome expectations. Specifically, social support for exercise positively influenced cardiac patients' efficacy beliefs and the outcomes expected from engaging in exercise. In fact, social support for exercise had the second largest total effect on exercise

intentions, albeit indirectly. This relationship has been supported by previous researchers (McAuley et al., 2003; Rovniak et al., 2002) and is in line with SCT. Results also demonstrated the important role of previous exercise on self-efficacy and outcome expectations. As posited by SCT, this implies that successful performance of activity in the past enhances beliefs that one may successfully overcome barriers to engage in activity and gain benefits. People who exercised regularly in the past likely developed strategies to overcome common barriers associated with regular exercise performance. In contrast to past studies that only showed a relationship between previous exercise and self-efficacy (Hagger et al., 2001; Resnick, 2001b), this study also found a link between previous exercise and outcome expectations. Finally, the present research revealed the significant influence of a supportive physical environment on self-efficacy. Specifically, results showed that greater access to home and community-based opportunities for exercise was associated with stronger self-efficacy perceptions in cardiac patients. To our knowledge, this is the first study to investigate the predictive power of a supportive physical environment on self-efficacy. Although not previously studied, these results are plausible when considered from the social cognitive perspective.

Study Limitations and Strengths

As noted, this research served as a preliminary study prior to embarking on a larger longitudinal cohort study. As such, some limitations exist. First, despite the use of a sophisticated statistical method (i.e., structural equation modeling), all explanatory and outcome variables were measured at one time. A cross-sectional design such as this is not able to establish causality or the sequence of events, making it difficult to confirm the model's ability to predict future exercise intentions. However, a recent comparison in the exercise domain showed that results from cross-sectional and longitudinal designs are similar in predicting exercise outcomes

(Rhodes & Plotnikoff, 2005). Second, the timing of the survey may have affected participant responding. Questionnaires completed post-cardiac event likely inflate the participants' exercise intentions, or reduce self-efficacy beliefs. Third, our social support questionnaire was brief and unidimensional. Items measuring both positive and negative experiences in patients' social environments might provide further information regarding exercise determinants in this population. Fourth, this sample was over-represented by educated non-smokers – two characteristics which are correlated with exercise behaviour. We are unsure whether lower education participants or smokers would respond differently to the questionnaire items. Therefore, caution should be used when generalizing to other patients with CAD. Finally, as many patients had a recent cardiac-related hospitalization, this study was not able to examine actual exercise behaviour. Although intentions are linked to behaviour (Bauman et al., 2002; Plotnikoff & Higginbotham, 2002), exercise behaviour – not intentions – produces the health benefits. Further studies examining the impact of these environmental and social cognitive variables on cardiac patients' exercise behaviour are warranted. A longitudinal cohort study examining these relationships with cardiac patients is underway.

This study also has several strengths. First, this project used a strong theoretical framework, namely SCT, to better understand exercise intentions. As such, researchers may formulate more advanced models of exercise and develop new interventions guided by theory. In addition, the study allowed for an examination of and provided evidence for theoretical relationships between SCT variables. Specifically, the relationship between self-efficacy and outcome expectations, and the influence of social support for exercise and previous exercise on self-efficacy and outcome expectations was explored. Second, unlike past exercise research that has relied on correlational or multiple regression analyses (Masse, Dassa, Giles-Corti & Motl,

2002), we employed structural equation modeling to test this conceptual model. The advantage of this method is that parameter estimates of the relationships between the variables are corrected for measurement error. In addition, the estimates are conducted simultaneously enabling direct and indirect comparisons of the relationships between multiple variables (Masse et al., 2002; Tabachnick & Fidell, 2007). Although we cannot make causal statements, the resulting model is a preliminary step toward illuminating the relationships between environmental, interpersonal, and intrapersonal variables on exercise intentions. Third, most exercise determinant research has been conducted with the general population. The current study added to the exercise research by examining exercise perceptions and intentions of individuals encountering a life threatening illness. Finally, this was the first study to examine the role of the physical environment on cardiac patients' exercise self-efficacy and intentions. Based on the results, future research should continue to assess environmental factors as important contributors to exercise outcomes.

In summary, the present results demonstrated that self-efficacy and outcome expectations have a positive and direct impact on exercise intentions in patients with CAD. Further, cardiac patients' social and physical environments operated through self efficacy and outcome expectations. Therefore, each variable studied proved its importance in the prediction of exercise intentions and warrants inclusion in the longitudinal study and future interventions.

From an applied perspective, exercise intentions could be fostered by increasing cardiac patients' confidence to overcome barriers to exercise and build upon their anticipated gains from engaging in that activity. As the model suggests, self-efficacy and outcome expectations may be enhanced by social support for exercise, previous exercise, and a supportive physical environment. Health care providers should be encouraged to identify individuals with low self-

efficacy and outcome expectations, as well as impoverished social and physical environments and implement interventions to strengthen these variables.

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Table 1. Descriptive characteristics of Study Participants

| Variable | Mean \pm SD, or percentage |
|--------------------------------------|------------------------------|
| Age | 64 years (\pm 9.73) |
| Gender | |
| Male | 79 % |
| Female | 21 % |
| Education | |
| < High school | 13 % |
| High school | 18 % |
| Trade college/some university | 18 % |
| University | 51 % |
| Employment Status | |
| Employed | 33.5 % |
| Retired | 54.5 % |
| Disability/Unemployed | 12 % |
| Income | |
| <24999 | 13 % |
| 25000 – 39999 | 10.5 % |
| 40000 – 59999 | 26 % |
| 60000 - 79999 | 19 % |
| 80000+ | 31.5 % |
| Marital Status | |
| Married, common law | 78 % |
| Single, separated, divorced, widowed | 22 % |
| Smoking Status | |
| Smoker | 8 % |
| Quit in last 6 months | 10 % |
| Quit over 6 months ago | 45 % |
| Life-long non-smoker | 37 % |
| Past Exercise (GLTEQ) | 18.62 (16.17) |

Table 2. Descriptive Statistics of the Model Predictors

| Variables | Mean (SD) or % with item/access |
|---------------------------------------|------------------------------------|
| Self-efficacy | 4.73 (1.33) |
| Outcome expectations (total) | 3.72 (.92) |
| Psychologic | 3.84 (1.01) |
| Body image/health | 3.92 (1.04) |
| Fun | 3.88 (1.21) |
| Social | 2.74 (1.25) |
| Social Support | 1.36 (.92) |
| Supportive Physical Environment (/31) | 14.0 (5.32) |
| Neighbourhood (/6) | 3.56 (1.28) |
| Sidewalks | 68 % |
| Heavy traffic | 27.5 % |
| Hills | 72.5 % |
| Street lights | 72.5 % |
| Enjoyable scenery | 63.3 % |
| Sidewalks cleared of snow | 44 % |
| Home (/13) | 4.50 (2.93) |
| Treadmill | 46 % |
| Rowing machine | 24 % |
| Stationary bicycle | 49 % |
| Outdoor bicycle | 42.5 % |
| Cross-country ski simulator | 10% |
| Elliptical/step machine | 17 % |
| Skis (downhill or cross-country) | 32 % |
| Skates | 33 % |
| Weight training equipment | 42 % |
| Heart rate monitor | 26 % |
| Running/walking shoes | 74 % |
| Golf clubs | 34 % |
| Home exercise video | 21 % |
| Community Facilities (/12) | 5.95 (3.11) |
| Fitness facility | 54 % |
| Jogging/walking path | 68 % |
| Bicycle path/lane | 59 % |
| Swimming lap pool | 43 % |
| Racquet club/courts (e.g., tennis) | 28 % |
| Aerobic exercise class | 44 % |
| Golf course | 46 % |
| Suitable area for walking | 78 % |
| Indoor shopping mall | 60 % |
| Ski trails | 44 % |
| Skating rink | 44 % |
| Martial arts studio | 26 % |

Table 3. Internal Consistencies (diagonal) and Pearson Correlations (above diagonal) among the SCT variables, previous physical activity, and exercise intentions.

| Variable | SS | SPE | SE | OE | INT | GLTEQ |
|---------------------------------------|-----|-------|-------|-------|-------|-------|
| Social Support (SS) | .82 | .21** | .26** | .31** | .26** | .05 |
| Supportive Physical Environment (SPE) | | .79 | .28** | .20** | .24** | .13 |
| Self-Efficacy (SE) | | | .96 | .25** | .68** | .28** |
| Outcome Expectations (OE) | | | | .94 | .32** | .21** |
| Exercise Intentions (INT) | | | | | .80 | .37** |
| Previous Exercise (GLTEQ) | | | | | | - |

Note: Cronbach's alpha applied for internal consistencies; ** $p < .001$, * $p < .05$

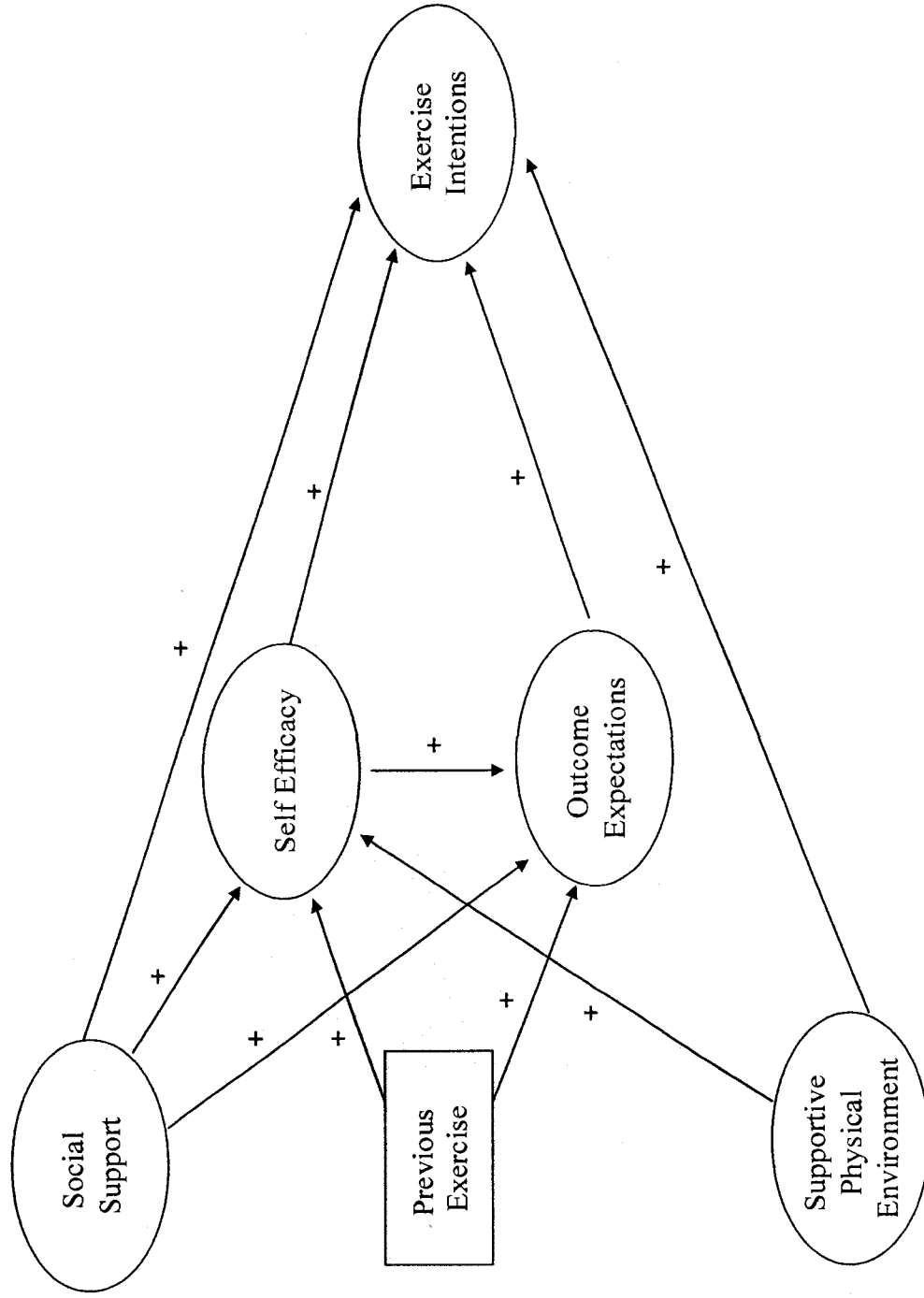
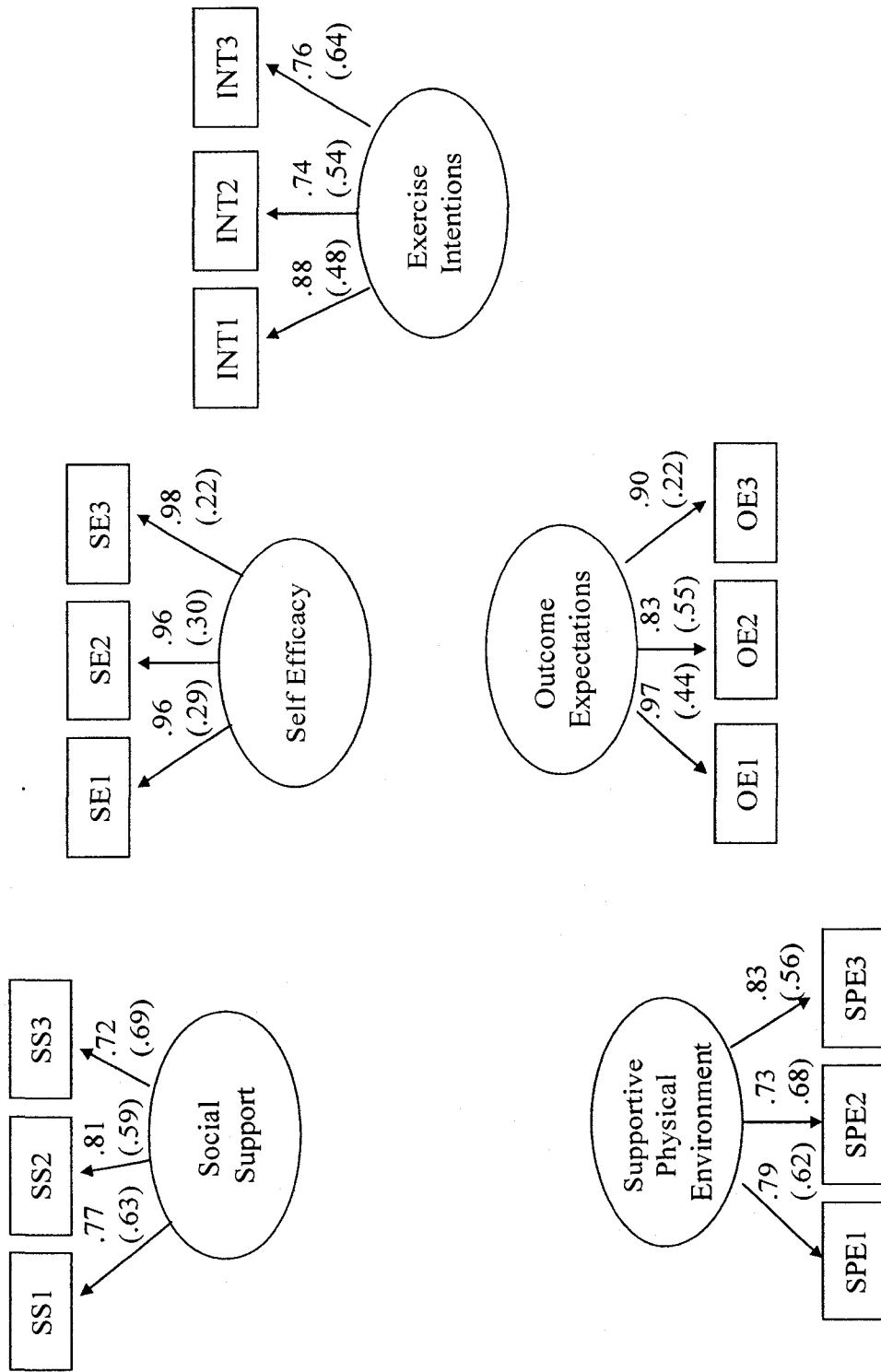


Figure 1. Hypothesized Model of Exercise Intentions



CFI = .97
RMSEA = .07

Figure 1. Measurement Model

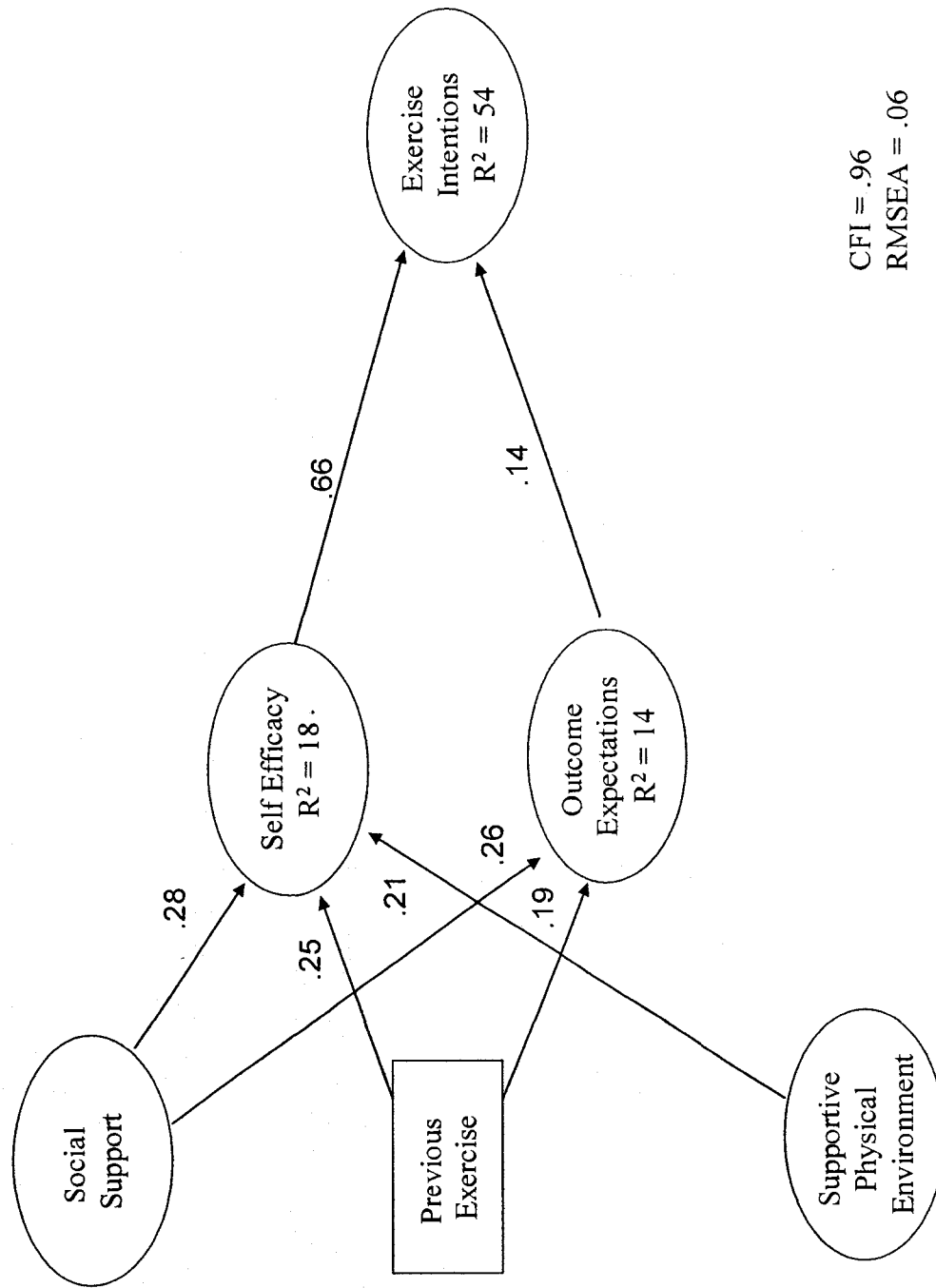


Figure 3. Resulting Model of Exercise Intentions – Significant paths only ($p < .05$)

CHAPTER III

PERSONAL AND ENVIRONMENTAL DETERMINANTS OF EXERCISE IN PATIENTS WITH CORONARY ARTERY DISEASE: EVALUATING A SOCIAL- COGNITIVE MODEL

Running Head: PERSONAL AND ENVIRONMENTAL DETERMINANTS

Personal and Environmental Determinants of Exercise in Patients with Coronary Artery Disease:
Evaluating a Social-Cognitive Model

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ABSTRACT

Background: To develop more effective interventions for patients with coronary artery disease (CAD), a better understanding of the determinants of exercise over time is needed.

Purpose: Using a prospective design, this study tested a social cognitive model of exercise behaviour 6 and 12-months after a cardiac-related hospitalization. Specifically, we examined the relationships between previous exercise, physiological feedback, positive and negative social environments, supportive physical environments, self-efficacy, outcome expectations, and exercise intentions and behaviour over time.

Method: Patients with documented CAD (N = 801) completed a survey at hospital discharge and 6 and 12 months later.

Results: Structural equation modeling yielded a good fit to the data. Overall, the social cognitive model accounted for 22% and 34% of exercise behaviour at 6 and 12 months post-hospitalization, respectively. Results indicated that previous exercise exerted the largest total effect on exercise at both time points, followed by self-efficacy. At 6 months, supportive physical environments and exercise intentions also had significant and direct links to exercise behaviour. At 12 months, outcome expectations were also influential modifiable predictors.

Conclusion: This study helped clarify the relations among SCT variables and exercise behaviour in patients with CAD. The results indicate that factors predicting exercise in the early stages of recovery differ from those in the long-term. Future research that continues to assess the relative importance of personal and environmental determinants over time is warranted.

KEY WORDS: social cognitive theory, exercise, determinants, coronary artery disease

Personal and Environmental Determinants of Exercise in Patients with Coronary Artery Disease:
Evaluating a Social-Cognitive Model

INTRODUCTION

Cardiovascular disease is the number one cause of death in the world, with coronary artery disease (CAD) at the top of the list (1). Regular exercise has been identified as an important secondary prevention behaviour as it reduces disease progression and mortality, and increases functional capacity and quality of life (2-4). Yet, many patients with CAD do not meet current exercise recommendations of at least 30 minutes of exercise at a moderate intensity or greater on most days of the week (5,6). In fact, only 59%, 50%, and 46% of cardiac patients achieve optimal levels of exercise 2, 6, and 12 months after a cardiac-related hospitalization, respectively (7). Therefore, new interventions are needed to enhance activity levels in this population.

To develop more effective interventions for patients with heart disease, a better understanding of the determinants of exercise behaviour is needed. Theory-based health behaviour change models have been identified as the preferred method for exploring significant modifiable exercise determinants (8). These theories are useful for identifying important determinants, informing the development and delivery of interventions, and guiding evaluations of these interventions (9). Despite these benefits, studies on patients with heart disease are rarely theoretically driven (10).

Social cognitive theory (SCT; 11) has been successful in predicting exercise behaviour in healthy adults (12,13). Indeed, SCT has accounted for up to 60% of the variability in exercise behaviour (14,15). SCT posits that behaviour is a function of personal and environmental characteristics. Key SCT variables include the social and physical environment, self-efficacy,

outcome expectations, and personal goals (11,16). However, exercise researchers using SCT typically examine only one or two theoretical constructs (17,18). In addition, few studies have examined the relationships between the SCT variables to better understand the processes which underlie the behaviour. Finally, apart from self-efficacy, few studies have examined the relative importance of SCT constructs in the cardiac domain (19,20).

Bandura (16) noted that personal and proximal goals are equivalent to intentions that immediately precede behaviour. Studies show that intentions predict exercise behaviour in healthy individuals (15,21) and cardiac populations (10). Self-efficacy has also been shown to be a strong predictor of exercise intentions and behaviour in both groups (10,22-24). In contrast, the predictive power of outcome expectations has been less apparent. In fact, previous studies have found that outcome expectations contribute very little to moderate amounts of variance in exercise (15,25,26). SCT argues that self-efficacy influences outcome expectations (27), yet few studies have investigated this link. Two studies confirmed this positive relationship (15,28), but additional research is required.

SCT highlights personal and environmental sources of information for self-efficacy and outcome expectations (11,27). Personal factors include previous experience and physiological feedback (i.e., emotional or physical responses to exercise). Although rarely studied, these variables show promise in predicting self-efficacy (29-31). Their impact on outcome expectations is less clear (14,31). Environmental factors (social and physical) are also expected to inform efficacy beliefs and expectations. Bandura (11) suggested that aspects of one's social environment such as verbal persuasion (i.e., encouragement from a credible source to exercise) enhance self-efficacy and outcome expectations. Research has supported this theoretical relationship in some (15,30), but not all studies (32). The relationship with outcome expectations

has been less commonly studied. However, as outcome expectations are viewed as a primary motivational variable for behaviour, studies examining this relationship are warranted (8). Most studies investigating social environmental variables concentrate on facilitators (e.g., social support), but Bandura (11) also spoke of impediments. It is plausible that cardiac patients encounter negative social environments (i.e., environments that criticize or inhibit exercise) that hinder the development of strong efficacy beliefs and expectations. Coyne and Smith (33) found that partners of patients with heart disease discouraged exercise due to fear of inducing future cardiac problems. However, previous studies have not examined the impact of a negative social environment on self-efficacy and outcome expectations. Finally, SCT states that supportive physical environments (i.e., environments in which exercise resources are present and available) enhance self-efficacy and outcome expectations (8), yet no studies examining these relationships were found in the published literature for healthy adults or cardiac patients. Research examining this relationship may shed additional light on the sources of information for self-efficacy and outcome expectations.

In addition to their contributions via self-efficacy and outcome expectations, previous exercise, positive and negative social environments, and supportive physical environments have been directly linked to exercise behaviour in healthy adults (24,31,34-37). For example, a positive social environment has been found to be a predictor of exercise in patients with cardiac problems (38). However, the opposite result has also been found (22,39). Factors in the physical environment may have a greater impact on cardiac patients' exercise behaviour than on their healthy counterparts. For example, fear of future heart problems may inhibit exercise behaviour except when supervised by a health professional (e.g., cardiac rehabilitation programs). Again, no published studies focusing on the link between environmental variables and exercise in the

cardiac population were found. In summary, both indirect and direct paths between previous exercise and environmental variables warrant inclusion in a SCT model predicting exercise behaviour.

Finally, numerous methodological limitations from past studies should be improved. First, most of the studies investigating exercise determinants in patients with CAD included convenience samples, that is, participants from cardiac rehabilitation programs (10,22,38). It is unclear how representative cardiac rehabilitation participants are of the total cardiac population. For example, cardiac rehabilitation programs appear to attract lower than expected numbers of women, the less educated, and smokers (40,41). Second, previous investigations have mainly relied on cross-sectional data (32,42) and, with few exceptions, included follow-up assessments to a maximum of 6 months (30,43,44). Considering that regular sustained exercise is necessary for patients with heart disease to attain optimal health and prevent further risk, longitudinal studies are needed to understand the determinants of exercise behaviour over time. To date, research has revealed factors predicting exercise adoption may be different from those predicting maintenance and, therefore, should be studied separately (45,46). Third, studies exploring the relationships between SCT constructs and exercise have, for the most part, employed correlational or multiple regression analyses (47). Structural equation modeling (SEM) produces greater information about the SCT relationships as it evaluates direct and indirect effects simultaneously, while correcting for measurement error (48).

Accordingly, the present study used a prospective cohort design to test a social cognitive model of exercise in patients with CAD at two time-points using SEM. Specifically, we evaluated the relationships between previous exercise, physiological feedback, positive and negative social environments, supportive physical environments, self-efficacy, outcome

expectations, and exercise intentions and behaviour at 6-months (time 1) and 12-months (time 2) following a cardiac-related hospital admission. As such, we were able to compare the exercise determinants at both time points. Relationships between the SCT variables in the model were hypothesized to be the same; therefore, the following hypotheses presented are applied to both time points (see Figure 1). Based on SCT, it was hypothesized that previous exercise, physiological feedback, and social and physical environments would influence exercise-related self-efficacy and outcome expectations. More precisely, we anticipated that more experience with exercise would lead to greater confidence to exercise in the future as well as more perceived benefits of engaging in the behaviour. Further, higher levels of social support for exercise and greater access to a larger number of exercise resources are expected to predict higher confidence to overcome barriers for exercise. In contrast, more frequent encounters with environments that have few exercise resources or that criticize/inhibit exercise behaviour are hypothesized to be associated with lower perceptions of exercise self-efficacy and outcome expectations. Similarly, we expected that somatic symptoms such as shortness of breath would be predictive of lowered self-efficacy and outcome expectations. In addition to their effects on self-efficacy and outcome expectations, it is expected that each of these variables impact exercise behaviour indirectly via self-efficacy and outcome expectations. In addition, self-efficacy and outcome expectations are hypothesized to predict exercise intentions which, in turn, predict exercise behaviour. In line with SCT, this hypothesis predicts that people who have higher confidence in their abilities to perform physical exercises despite barriers and who have greater expectations of the potentially positive benefits of engaging in the activity have stronger intentions to be active. Therefore, self-efficacy and outcome expectations are expected to influence exercise behaviour, in part, through their influence on exercise intentions.

In addition to their indirect effects via self-efficacy and outcome expectations, previous research has shown that the previous exercise and social and physical environments have direct links to exercise behaviour. Previous exercise was hypothesized to be positively associated with higher levels of exercise behaviour over time. We also anticipated a positive relationship between the social environment (e.g., social support for exercise) and exercise behaviour. The reverse was expected for negative social environments. That is, greater levels of criticism or more frequent advice to avoid activity would lead to lower levels of exercise. Studies with healthy adults lead us to predict that more enriched physical environments for exercise will lead to higher levels of behaviour. Similarly, we hypothesized that self-efficacy and outcome expectations would have a direct impact on exercise behaviour, in addition to the indirect effects noted above. Finally, as Bandura noted (2004), exercise intentions are the proximal determinant of behaviour and, therefore, are anticipated to be directly linked to exercise outcomes.

METHOD

Participants and Procedures

Participants were taken from the *Tracking Exercise After Cardiac Hospitalization* study (7). Specifically, adults with documented CAD (e.g., myocardial infarction, percutaneous coronary intervention, coronary artery bypass graft) were recruited after a cardiac-related admission from three tertiary care hospitals in Eastern Ontario (University of Ottawa Heart Institute, The Ottawa Hospital, Kingston General Hospital). Exclusion criterion included contraindications to exercise (e.g., unstable angina, uncontrolled cardiac arrhythmias) and an inability to read in English. The study did not require or request participants to begin an exercise program at any time nor did it suggest any limitation to activity. Instead, participants were

informed that the research goal was to understand the experiences of patients with heart disease in relation to exercise after a cardiac problem requiring hospitalization.

Participants completed questionnaires including medical, demographic, psychosocial, and exercise scales at hospital discharge (i.e., baseline) and returned them to the study coordinator on site or by mail. Follow up questionnaires and stamped envelopes were mailed to participants 2, 6, and 12 months after entry into the study. A sample of individuals that declined participation completed a short demographic questionnaire. Approval of the study protocol was obtained from the Research Ethics Committee at each of the acute cardiac care centres. All participants provided written informed consent.

Measures

Demographic Characteristics included age, gender, ethnicity, education, income, location of residence, weight, height, and employment, marital and smoking status.

Cardiovascular Medical History. Patients reported their cardiac-related medical history and co-morbid conditions (e.g., congestive heart failure, diabetes). The reason for their current hospitalization was obtained from their medical records.

Physiological Feedback. Patients indicated (yes/no) if they experienced shortness of breath and angina symptoms. If so, they reported the extent to which these symptoms limited their exercise behaviour (1 = not at all, 4 = extremely). The items showed good internal consistency ($\alpha = .74$).

Social Environment. Positive and negative aspects of the social environment were assessed with a shortened version of a previously validated measure (35). On a 5-point scale ranging from never (0) to very often (4), participants indicated how often family, friends, and experts (e.g., physician, nurse) made positive or negative comments concerning exercise.

Indicators of a positive social environment included eight items taken from three subscales including companionship (e.g., offered to participate in exercise with me), information (e.g., informed you about the expected positive effects of exercise), and esteem support (e.g., complimented you on the mastery of your exercise skills). Indicators of a negative social environment included four items from two subscales including inhibitive (e.g., advised you to avoid exercise in order to avoid injury or ill health) and criticizing (e.g., criticized your low skill level in exercise). Overall, the positive and negative measures demonstrated good internal consistency ($\alpha = .94$ and $.83$, respectively).

Supportive Physical Environment. Two aspects of the physical environment were assessed: home equipment and access to community facilities. Specifically, participants' indicated whether or not (yes/no) they had exercise resources in their home (e.g., running shoes, treadmill), and if they had convenient access to facilities (e.g., walking/biking paths). This questionnaire was modified from the original measure (46) to include items for the winter season in Canada (e.g., skis, skating rink). The measure was found to be internally consistent ($\alpha = .86$).

Self-efficacy was measured with a previously validated 12-item scale used with patients with CAD (49). Patients were asked to rate their confidence (1 = not at all confident; 7 = completely confident) to engage in regular exercise (i.e., 30 minutes or more of exercise at a moderate intensity or greater four or more days of the week) when presented with various obstacles (e.g., feeling depressed, bored with the activities). This questionnaire also demonstrated high internal consistency in this sample ($\alpha = .95$).

Outcome Expectations. Three subscales from Steinhardt and Dishman's (50) previously validated scale assessed participants' perceived benefits of exercise. One item about cardiac health was also added by the researchers. More precisely, participants rated their level of

agreement (1 = do not agree at all; 7 = completely agree) with 11 statements about possible exercise outcomes (e.g., release of tension, maintain or lose weight). This scale exhibited good internal consistency ($\alpha = .90$).

Exercise Intentions were assessed with three items developed and validated by Courneya and colleagues (51). On a 7-point scale (1 = do not agree at all; 7 = completely agree), participants reported the extent to which they agreed with the statements “I intend to exercise regularly over the next month” and “I intend to exercise regularly over the next 6 months.” Patients also reported the frequency (i.e., number of times per week) in the next six months that they intended to exercise for 30 minutes or more at a moderate intensity. The three items demonstrated high internal consistency ($\alpha = .86$).

Exercise Behaviour. The Godin Leisure-Time Exercise Questionnaire (GLTEQ; 52) was used to assess participants’ previous and current exercise behaviour. Patients reported the number of times they exercised for least 15 minutes at three intensity levels – mild, moderate, strenuous – during a typical week in the last 6 months. The GLTEQ yields a leisure activity score by summing the products of mild, moderate, and strenuous levels of exercise and their respective metabolic equivalence value (i.e., 3, 5, 9, respectively). Scores above 24 are consistent with current exercise guidelines (N. Bertrand, G. Godin, 2004, personal communication). An independent evaluation of this instrument found it to be reliable and valid (53).

Data Analyses

SEM using EQS 6.1 Structural Equations Program (54) was used to test the fit of the measurement and structural equation model of exercise outcomes to the empirical data. At time 1, exercise behaviour 6 months post-hospitalization was predicted using SCT variables measured at baseline and 2 months. Previous exercise, physiological feedback, and physical environmental

variables were assessed at baseline. The social environmental questionnaire was gathered at the 2-month mark to provide patients the opportunity to interact with all social sources (i.e., family, friends, health experts) post cardiac event. For example, patients typically meet with their physician 4-6 weeks post-hospitalization and have little to no interaction before this time. As paths led from the social environment to self-efficacy and outcome expectations, and further on to exercise intentions, these variables were also measured at 2 months. At time 2, exercise behaviour at 12 months was predicted using SCT variables measured at 6 months.

Prior to conducting SEM analyses, preliminary analyses were conducted to compare study participants with non-participants, and to identify and explore missing data. The measured variables were then examined for normality. Next, descriptive analyses were performed to provide summary statistics on each of the variables under study. Finally, the measurement and SEM estimation were performed using the maximum likelihood fitting function (55). In the case of significant skewness or kurtosis, maximum likelihood estimation (robust) would be employed and tested with the Satorra-Bentler scaled chi square (58). For the purpose of identification, the loadings between the first indicator of each latent construct and its target factor were fixed to 1.0. In light of the controversies concerning measures of overall fit (48,56), a number of fit indexes were employed to evaluate the overall model fit. In line with the current state of practice and recommendations regarding written summaries of SEM analyses (48), these included the comparative fit index (CFI), root mean square error of approximation (RMSEA), standardized root mean square residual (SRMR), and the model chi-square (χ^2). Acceptable model fit is generally indicated when CFI values are greater than .90, and the RMSEA and SRMR are less than .10 (48). The squared multiple correlation (R^2) was used to evaluate the effectiveness of the

model in explaining variance observed in the sample's exercise-related self-efficacy, outcome expectations, intentions and behaviour.

RESULTS

Preliminary Analyses

Of the 1433 patients approached, 826 agreed to participate (57.6%). To assess the representativeness of the sample, 446 patients who declined participation completed a brief survey. No differences between study participants and non-participants were found for age, gender, employment status, and reason for hospitalization (i.e., cardiac diagnosis). Participants were more educated, less likely to be smokers, and more likely to be active prior to their hospitalization (p s = $<.01$) when compared to non-participants.

In the 12 months post-hospitalization, 25 patients died and were excluded from the analyses. Of the remaining 801 patients, all completed the baseline questionnaire. Further, 623 participants (78%) returned the questionnaire at 2-month, and 577 participants (72%) completed the questionnaire at 6 and 12 months. As the data was missing at random, unbiased estimates were calculated using the expectation maximization algorithm (57). Before conducting the EM algorithm, the data was checked for univariate skewness. Results showed that the distribution of scores for exercise was skewed; cell values above a Z-score of 3.29 were deleted (58). The data was re-checked after running the EM algorithm. Subsequently, 31 participants (3.8%) were removed from the analysis due to multivariate outliers. This yielded a final sample of 770 patients. In addition, although the negative social environment did not surpass the maximum accepted level for univariate skewness and kurtosis (48), these values were somewhat elevated (2.2 and 5.3, respectively). Therefore, we tested the structural model with the robust function (i.e., Satorra-Bentler).

Descriptive Characteristics

The characteristics of the overall sample are presented in Table 1. Participants had a mean age of 61.4 years, and were mainly male, Caucasian, educated, and non-smokers. Reasons for their most recent cardiac-related hospitalization included myocardial infarction (36.6%), percutaneous coronary intervention (37%) and coronary artery bypass graft (26.4%).

Social Cognitive Variables and Exercise Behaviour

Table 2 presents participants' scores for the social cognitive predictors in the model at time 1 and time 2. Participants reported their previous exercise levels at baseline and 6 months. The average score on the GLTEQ was 23.2 ± 20.5 at baseline and 35.3 ± 21.5 at 6 months. Exercise levels increased significantly over time. ($p = <.01$). In the 6 months prior to study enrolment, 60% of participants were insufficiently active to gain health benefits, and 34% of patients remained in this category at 6 months. Approximately 40% of patients reported angina and shortness of breath at baseline. The proportion of participants reporting these symptoms dropped significantly to about 25% by 6 months ($p = <.01$).

Regarding the environmental variables, participants reported low levels of positive or negative social encounters 2 months post-hospitalization. In the positive realm, they reported "sometimes" receiving support from their family and health expert. Most often this was in the form of informational support ($M = 1.8 \pm 1.01$). Patients stated that they "never" or "rarely" encountered a negative social environment. On occasion, they were met with inhibiting statements from others ($M = .62 \pm .81$). Scores on the social environment scales were very similar from baseline to 6-months; however, the slight decline on both scales was statistically significant ($ps = <.01$). In contrast to the social environment, most patients reported supportive physical environments for exercise. On average, participants had 3.8 of 13 possible exercise resources in

their home, and had access to 6.0 of 12 community facilities. At baseline, the most prominent resources in the home were running shoes and a bike (stationary or outdoor), owned by 81% and 41% of patients, respectively. Many patients also had access to community exercise facilities including walking paths (76%), shopping mall access for indoor walking (69%), golf courses (59%), fitness clubs (56%), skating rinks (56%), and swimming pools (54%). Participants' reported slight increases in the physical environment variables over the 6-month period. Statistically significant differences over time were found for exercise resources in the community, but not the home ($p = .01$ and $.22$, respectively).

At two months post-hospitalization, participants were moderately confident in their ability to overcome barriers to participate in exercise ($M = 4.8 \pm 1.3$) and had fairly high expectations of the possible exercise benefits ($M = 5.5 \pm 1.1$). Both self-efficacy and outcome expectations scores changed significantly over time ($ps = <.01$). Self-efficacy scores increased slightly, whereas outcome expectations declined from baseline to 6 months. At the point of hospital discharge, this sample of cardiac patients reported high intentions to be active over the next month ($M = 5.6 \pm 1.7$) and more so over the next six months ($M = 5.8 \pm 1.5$). In addition, they intended to exercise approximately 4 days per week. No differences were found from 2 months to 6 months all three of the exercise-intention measures ($ps >.10$).

In line with their intentions, the mean level of exercise reported at 6 and 12 months surpassed the recommended levels ($M = 35.4 \pm 21.5$ and 42.1 ± 30.3 , respectively). However, there was large variation amongst the sample. The proportion of patients exceeding the minimal goal of 24 on the GLTEQ was 67% and 70%, respectively. Over the 12 months, 34% of participants had enrolled in a cardiac rehabilitation program.

Model Testing

Measurement Model. The measurement component of the SCT model of exercise was evaluated to confirm the factor structure of the latent variables. This approach allows for the systematic detection and correction of any measurement problem liable to interfere with the assessment of the structural model (Byrne, 2006). The overall fit of the measurement model was very good ($\chi^2(149) = 394.89$, $p < .001$; CFI = .98; GFI = .95; RMSEA = .05; SRMR = .03). All factor loadings were significant at the .05 level. These values and their respective residuals (in parentheses) are displayed in Figure 2. Because the fit statistics from the measurement model indicated that the measures adequately represented each latent variable, we proceeded to tests of the structural model.

Time 1. As noted, SEM was used to test the hypothesized model of exercise 6 months post-hospitalization. The resulting model displaying the significant paths is presented in Figure 2. This model resulted in a satisfactory fit with the empirical data ($\chi^2_{(df=191, N=770)} = 559.86$, $p < .001$; CFI = .97; RMSEA = .05). As proposed in the theoretical model, all paths leading to self-efficacy were significant. Positive associations were found with previous exercise, and positive social and supportive physical environments. Inverse relationships were revealed for physiological feedback and negative social environments. Only self-efficacy and a positive social environment were significantly associated with outcome expectations. Exercise intentions were predicted by self-efficacy and outcome expectations. Finally, exercise behaviour was influenced directly by participants' previous exercise, self-efficacy, supportive physical environments, and exercise intentions. The model explained 19%, 25%, 52%, and 22% of the variance in self-efficacy, outcome expectations, intentions, and exercise behaviour at 6 months post-hospitalization, respectively.

The total effect of each latent variable on exercise was also examined. Total effects are the sum of indirect (portion of total effects mediated by other variables) and direct effects (48). Previous exercise had the greatest total effect on exercise 6 months post-hospitalization ($\beta = .34$), followed by self-efficacy ($\beta = .24$), exercise intentions ($\beta = .17$), supportive physical environments ($\beta = .15$), and positive social environments ($\beta = .13$). The remaining variables contributed minimally ($\beta < .07$).

Time 2. The social cognitive model was tested a second time to predict exercise in patients with CAD 12 months post-hospitalization. The resulting model displaying the significant paths is presented in Figure 3. This model also demonstrated a good fit to the data ($\chi^2_{(df=191, N=770)} = 528.97, p < .001$; CFI = .97; RMSEA = .05). Similar to the model at 6-months, all paths leading to self-efficacy were significant. Previous exercise was the strongest predictor of self-efficacy. Outcome expectations were predicted by previous exercise, self-efficacy, and positive social environments. The paths from self-efficacy and outcome expectations to exercise intentions were also positive and significant, and both variables had a significant and direct impact on exercise behaviour. In this test of the model, exercise intentions, supportive physical environments, and positive social environments did not predict exercise behaviour directly. This finding is contrary to hypotheses and unlike the 6-month model. However, supportive physical environment and positive and negative social environments had significant indirect effects on exercise behaviour via self-efficacy and/or outcome expectations. Exercise behaviour was significantly and positively associated with self-efficacy, outcome expectations and previous exercise. Overall, the amount of variance explained in self-efficacy (25%), outcome expectations (40%), and exercise behaviour (34%) was higher in this test of the model as compared to time 1. The variance in exercise intentions was found to be lower in this test of the model (19%).

Finally, total effects were calculated. Similar to time 1, previous exercise had the greatest total effect on exercise 12 months post-hospitalization ($\beta = .55$), well above the other predictors. In this test of the model, self-efficacy and outcome expectations also effected exercise behaviour ($\beta = .16$ and $.12$, respectively). The remaining variables had a negligible effect on exercise behaviour at 6 months ($\beta < .08$).

DISCUSSION

To achieve a greater understanding of the factors that lead to exercise in patients with CAD, this study used a prospective design to test a social cognitive model of exercise over time using SEM. We believe that this is the first study to evaluate a comprehensive set of SCT constructs in the prediction of exercise in patients with CAD. More specifically, the model examined the influence of personal and environmental factors on exercise 6 months and one-year following a cardiac-related hospitalization. The inclusion of physical environmental variables is novel in this population and extends research in this domain. Overall, the model provided a good fit to the data and explained 22% and 34% of the variance in exercise at 6 and 12-months post-hospitalization, respectively. The amount of variance accounted for in the model at each time point is similar to or above most behavioural and psychosocial models (30,32,59,60). Our findings suggest that SCT provides a useful framework in the prediction of exercise-related constructs in patients with heart disease over time.

Relations within our SCT model indicated that previous exercise exerted the largest total effect on exercise at both time points. This result adds support to the limited studies examining the role of previous exercise on current behaviour (14,30,36). This information suggests that interventions need to concentrate on mastery experiences, that is, the successful performance of the activity (11). This may involve self-monitoring of small and realistic steps when increasing

exercise levels in order to ensure success (61). In addition, it may be worthwhile for intervention participants to be stratified by previous exercise level. For example, people who exercised in the past likely have learned strategies to handle common exercise-barriers. Perhaps these individuals could be “fast-tracked” through interventions making programs more cost-effective.

Although the contribution from previous exercise was greater than self-efficacy, the results of this study indicate that self-efficacy is an essential component of exercise intentions and behaviour over time. This finding indicates that cardiac patients who feel more confident in their ability to exercise despite barriers have greater intentions to be active and engage in more exercise. These results are in line with previous research in healthy adults (32,62) and cardiac patients (10,63) and core postulates of SCT (27). Based on these results, interventions are likely more effective if self-efficacy is targeted. These interventions should focus on improving skills, problem-solving to address barriers, and augmenting supportive social and physical environments.

The role of outcome expectations varied over time. At 6 months, outcome expectations had an insignificant direct impact on exercise behaviour; instead, expectations influenced behaviour indirectly through exercise intentions. In contrast, a direct association was revealed in the model at 12 months. Cross-sectional studies have shown outcome expectations to be a significant predictor of exercise (14,31), but a longitudinal study found outcome expectations to be an insignificant predictor of activity at a 2-month follow-up (15). Consistent with SCT (27), outcome expectations had a weaker relationship to exercise than self-efficacy in our study. This finding is also in accordance with previous research (14,15,31). Overall, our results indicate that outcome expectations are important when initiating behaviour as they influence exercise intentions, however, as people gain experience with exercise over time, their perceived benefits

play a more direct and influential role. Interestingly, participants' reported level of outcome expectations dropped over time and the relationship to exercise became stronger. Perhaps people have unrealistic expectations initially, or their expectations are influenced by actual goals achieved over time. Future studies measuring both outcome expectations and the degree to which these expectations are met may provide supplementary information. In general, more longitudinal research examining the role of outcome expectations is needed.

Results from this study indicated that the physical environment influences exercise indirectly and directly. Specifically, greater access to exercise resources in one's home or community led to more exercise soon after a cardiac event. A supportive physical environment was also associated with long-term exercise, however, its influence was exerted through self-efficacy. In line with SCT, environments rich in exercise resources were associated with enhanced self-efficacy. Interestingly, although most participants in our study did not change their residence, they reported greater access to more community resources at 6 months than at baseline. This finding implies that participants became more aware of potential exercise resources and were proactive in accessing them. Previous research with healthy adults has examined the link between the physical environment and exercise, and the findings have been similar to ours (32,34,64). We believe this is the first study to consider the influence of the physical environment on cardiac patients' self-efficacy and exercise behaviour. Practically speaking, our results suggests that strategies such as making people more aware of resources in their community (e.g., provide an information sheet that outlines exercise facilities in the participant's community) and providing basic resources to those in need (e.g., running shoes) should lead to improved self-efficacy and increased activity.

Contrary to hypotheses and SCT, the social environment did not have a direct impact on exercise behaviour at either time point. Previous research has shown a consistent link between positive social environments and exercise in healthy adults (24,34,65), but this connection is less reliable in patients heart disease. Two other studies including patients with CAD found that social support did not predict exercise (22,39), whereas another revealed a significant association. However, each sample was very small ($n < 81$) and included cardiac rehabilitation participants only. Our study included a large sample, but participants reported low levels of social support. Perhaps this level is sufficient to enhance self-efficacy and outcome expectations, but a greater amount of support is needed for actual behaviour to occur. Future studies are needed to clarify the impact of positive social environments on exercise behaviour in this population.

From a theoretical perspective, further evidence is provided regarding the sources of information for self-efficacy and outcome expectations. Most relationships predicted by SCT were observed in the data. Specifically, all paths leading to self-efficacy in our model were found to be significant, as were some paths leading to outcome expectations. Consistent with theory (11), previous exercise was a central component in the formation of efficacy beliefs. Physiological feedback was inversely associated with self-efficacy suggesting that experiencing shortness of breath and angina symptoms undermines exercise confidence. Consistent with our finding, Bandura (27) noted that self-efficacy is influenced by somatic symptoms in those of compromised health. In a similar line, Resnick (31) found that good health was associated with self-efficacy. Future intervention might investigate whether participants' perception of their somatic symptoms are realistic or exaggerated. For example, if somatic symptoms are inflated due to negative cognitions (e.g., fear), interventions could teach cognitive strategies to reinterpret

somatic symptoms enabling participants to decrease fears and continue exercising. Social interactions also influenced self-efficacy and outcome expectations. Not surprisingly, our results indicate that positive statements from family, friends, or health experts lead to higher confidence and greater perceived benefits. These results extend research by replicating the theoretical relationship shown in the general population to cardiac patients (15,30). In contrast, criticizing or inhibiting comments were associated with lower self-efficacy. Based on our results, interventions focusing on exercise-related self-efficacy and outcome expectations may be improved by including family members. For example, if significant others are included in education sessions they may obtain information regarding the cardiac care, recovery of their loved one, benefits of activity, and have their concerns addressed. In addition, teaching positive communication strategies to help increase patients' confidence may be useful, especially in the early stages of recovery. A recent review reported that family interventions after a cardiac event are effective at improving self-efficacy in the patient (66). A systematic evaluation of the incremental effect (if present) of family involvement is needed in the exercise domain. Finally, this study also adds to the paucity of research investigating self-efficacy's impact on outcome expectations. In line with previous research (15,31), we discovered that self-efficacy was strongly associated with outcome expectations. As SCT argues (27), our results show that confidence to exercise at a criterion level despite barriers is associated with greater perceived benefits in the activity.

The results of our exercise model at 6-months showed that self-efficacy and outcome expectations predicted exercise intentions which, in turn, predicted behaviour. Intentions were also predicted by these two variables at 12-months, but the link to exercise was no longer significant. Similar to our findings from the model tested at time 1, Blanchard and colleagues (10) demonstrated that intentions predicted exercise in patients attending a 6-month cardiac

rehabilitation program. In addition, like our model tested at time 2, a recent study investigating exercise 12 months after a brief cardiac rehabilitation program found that intentions did not predict exercise behaviour (23). Further testing of this model is needed over time to clarify the role of intentions on exercise behaviour. Perhaps the addition of a qualitative measure of motivation (e.g., extrinsic/intrinsic) rather than the simple quantitative measure (e.g., how often patients intend to exercise in a week) would provide more information.

Finally, our results show that the exercise determinants for patients with CAD change over time. As mentioned above, previous exercise and self-efficacy were the strongest predictors of exercise behaviour at both time points. When exercise was initiated soon after a cardiac event, supportive physical environments and exercise intentions were also influential. Although indirect, the social environment also played a significant role. In fact, as time progressed, both the social and physical environments exerted their effect primarily through self-efficacy and outcome expectations. These latter variables continued to be important direct predictors of exercise 12-months post-hospitalization. In fact, outcome expectations became more important at this time-point, than in the early recovery stage. More studies examining the relative influence of predictor variables across time are needed.

Study Strengths and Limitations

This study has numerous strengths. First, it is one of the few theory-driven studies examining the determinants of exercise in patients with CAD, and the first to explore a more comprehensive SCT model in this population. Accordingly, this study allowed for an examination of important SCT constructs underlying exercise behaviour, and the processes through which they work. Specifically, we provided evidence for essential sources of information for self-efficacy and outcome expectations, intentions and exercise. Using the above

results, new interventions to promote exercise in this target population may be developed. Second, as previously noted, this is the first study to investigate the impact of physical environmental variables on self-efficacy, outcome expectations and exercise behaviour in patients with heart disease. Also, the inclusion of negative social environmental variables was novel. These additional variables provide new information about exercise determinants in patients with CAD. Third, using longitudinal data, we were able to differentiate between exercise determinants at early and later stages of recovery from a CAD-related hospitalization. This study is one of few that have compared determinants over time. Fourth, as past exercise determinants research has focused on the general population, the present study extends research by studying individuals with heart disease. In addition, our sample was large and included cardiac patients with various cardiac conditions and those not enrolled in cardiac rehabilitation. This is an improvement over studies using convenience samples of cardiac rehabilitation patients only. Finally, the use of SEM analyses was a methodological strength.

Some study limitations warrant attention. Our sample differed on some demographic variables from individuals choosing not to participate. Nevertheless, we had a high participation rate that included a large portion of patients not attending cardiac rehabilitation and minimal loss to follow-up. Another limitation was the use of a self-report measure of exercise. The addition of an objective measure would be desirable. However, there is evidence that self-reported exercise behaviour is reliable and show comparable results to objective measures (67). In addition, although our model was based in theory, other important factors may account for additional variance in exercise behaviour. Still, our model explained over 30% of the variance in exercise behaviour at 12 months, a threshold suggested by Baranowski (59) that is high for psychosocial models and useful for intervention development.

In summary, this study helped clarify the relations among SCT variables and exercise behaviour in patients with CAD. The results suggest that multiple personal and environmental variables impact cardiac patients' exercise in the year following a cardiac-related hospital admission. At both time points, previous exercise had a strong influence on behaviour. People that have been active in the past might attend shorter cardiac rehabilitation programs and, subsequently, reduce financial costs involved in participation. Moreover, in the months immediately preceding cardiac-care in hospital, modifiable factors to be addressed include resources in the physical environmental, self-efficacy and exercise intentions. As patients become more active over time, self-efficacy and outcome expectations were directly related to exercise. These SCT constructs should be targeted for exercise over time. However, the environmental variables should not be ignored as they enhance these important personal factors. Future research that continues to assess the relative importance of personal and environmental determinants as well as the mechanisms underlying exercise behaviour is needed. As such, new advanced theories and intervention models may be developed and evaluated.

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Table 1. Sample Characteristics (N = 770)

| Variable | Mean (SD) or % |
|----------------------------|-----------------------|
| Age (years) | 61.4 (10.1) |
| Sex | |
| Male | 75.3 |
| Female | 24.7 |
| Education (years) | 12.8 (3.6) |
| Employment Status | |
| Working part or full-time | 41.3 |
| Retired | 50.4 |
| Disability/Unemployed | 8.3 |
| Income (\$) | |
| < 30 000 | 23.8 |
| 30 000 – 59 999 | 39.2 |
| ≥ 60 000 | 37.0 |
| Marital Status | |
| Married, Live Together | 80.5 |
| Single, Divorced, Widowed | 19.5 |
| Location of Residence | |
| Urban | 50.0 |
| Sub-urban | 17.8 |
| Rural | 32.2 |
| Smoking Status | |
| Smoker | 83.8 |
| Non-smoker | 16.2 |
| Reason for Hospitalization | |
| AMI | 36.6 |
| PTCA | 37.0 |
| CABG | 26.4 |
| Congestive Heart Failure | |
| Yes | 28.7 |
| No | 71.3 |
| Diabetes | |
| Yes | 21.0 |
| No | 79.0 |
| Body Mass Index | 28.6 (4.7) |

Table 2. Descriptive Statistics of the Social Cognitive Predictors of Exercise

| Variable | Time 1 M (SD), % | Time 2 M (SD), % |
|---|--------------------------|--------------------------|
| Previous Exercise (GLTEQ) | 23.2 (20.5) ^B | 35.4 (21.5) ⁶ |
| Physiological Feedback (% experiencing) | | |
| Shortness of Breath | 37.3 ^B | 21.4 ⁶ |
| Angina | 40.9 ^B | 26.4 ⁶ |
| Positive Social Environment | 1.5 (.87) ² | 1.3 (.87) ⁶ |
| Negative Social Environment | .37 (.44) ² | .30 (.44) ⁶ |
| Supportive Physical Environment | | |
| Home (/13) | 3.8 (2.9) ^B | 4.0 (2.9) ⁶ |
| Community Facilities (/12) | 6.0 (3.6) ^B | 6.3 (3.7) ⁶ |
| Self-Efficacy | 4.8 (1.3) ² | 4.7 (1.4) ⁶ |
| Outcome Expectations | 5.5 (1.1) ² | 4.6 (1.3) ⁶ |
| Exercise Intentions | | |
| One month | 5.6 (1.7) ² | 5.5 (1.6) ⁶ |
| Six months | 5.8 (1.5) ² | 5.7 (1.5) ⁶ |
| Weekly frequency | 4.4 (1.9) ² | 4.3 (1.8) ⁶ |

B = baseline; 2 = 2 months, 6 = 6 months

Time 1 = Predicting exercise 6-months post-hospitalization

Time 2 = Predicting exercise 12-months post-hospitalization

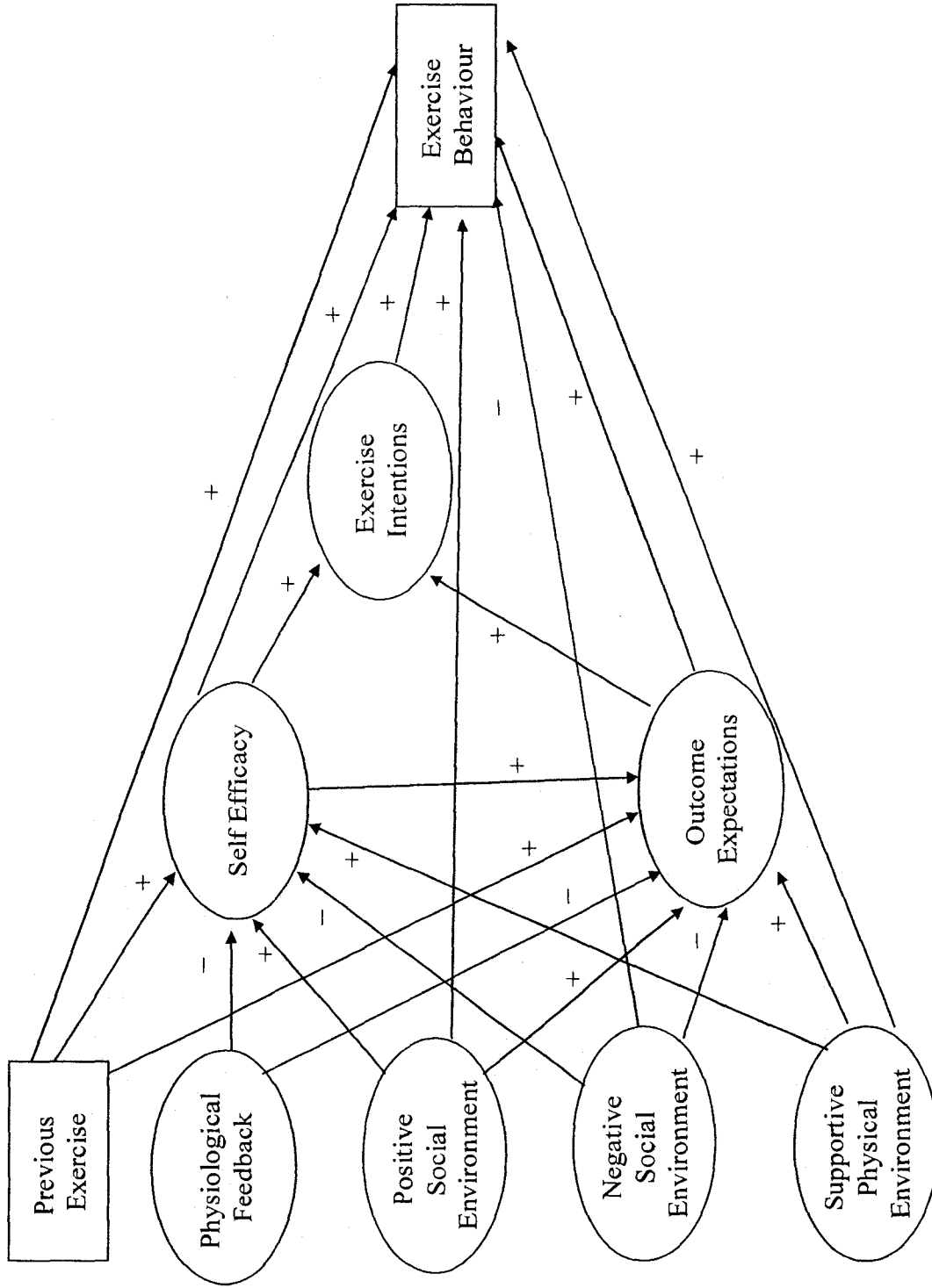
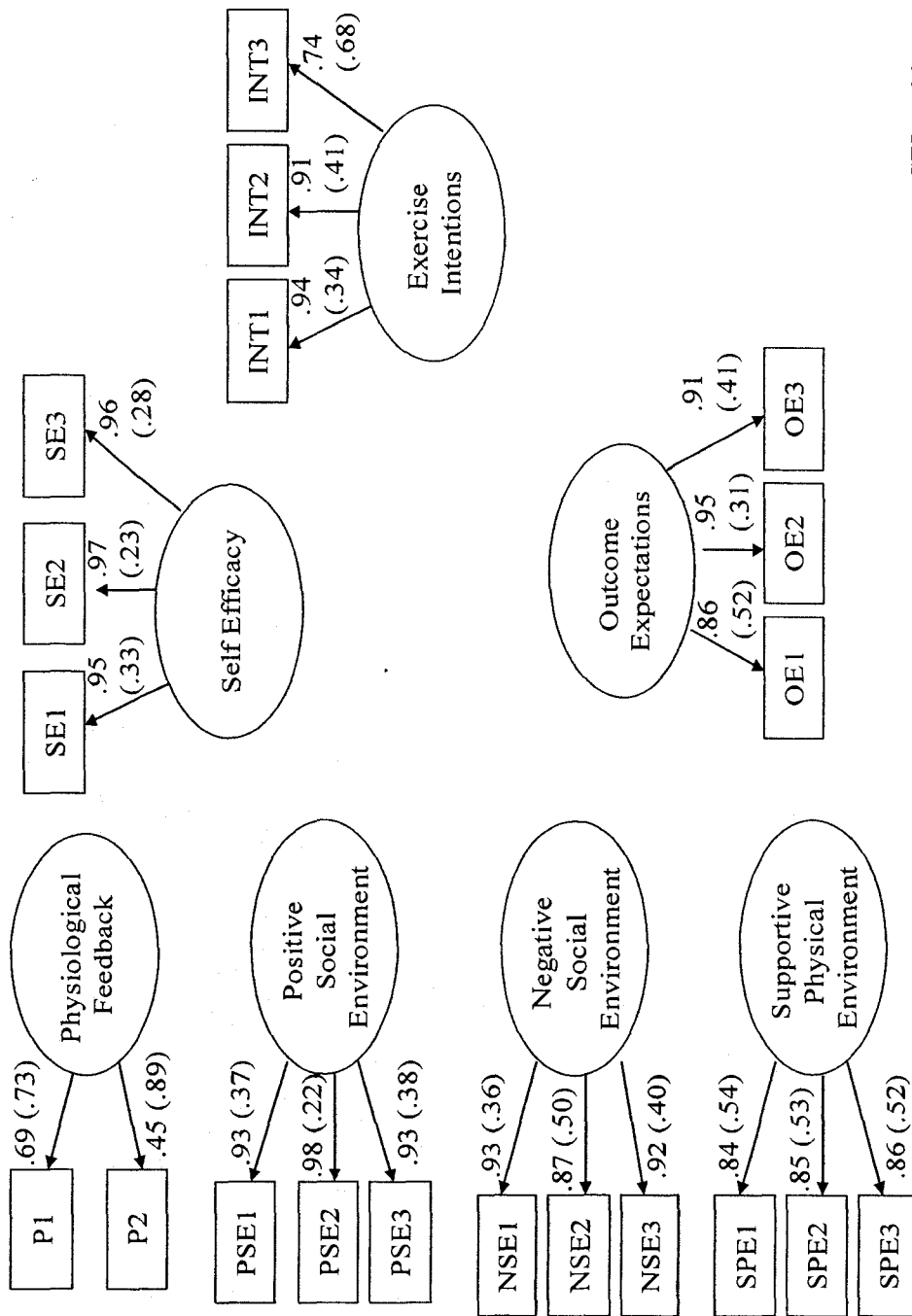


Figure 1. Hypothesized Relationships between the SCT Variables and Exercise Behaviour



CFI = .98
RMSEA = .05

Figure 2. Measurement Model – Factor Loadings and Residuals

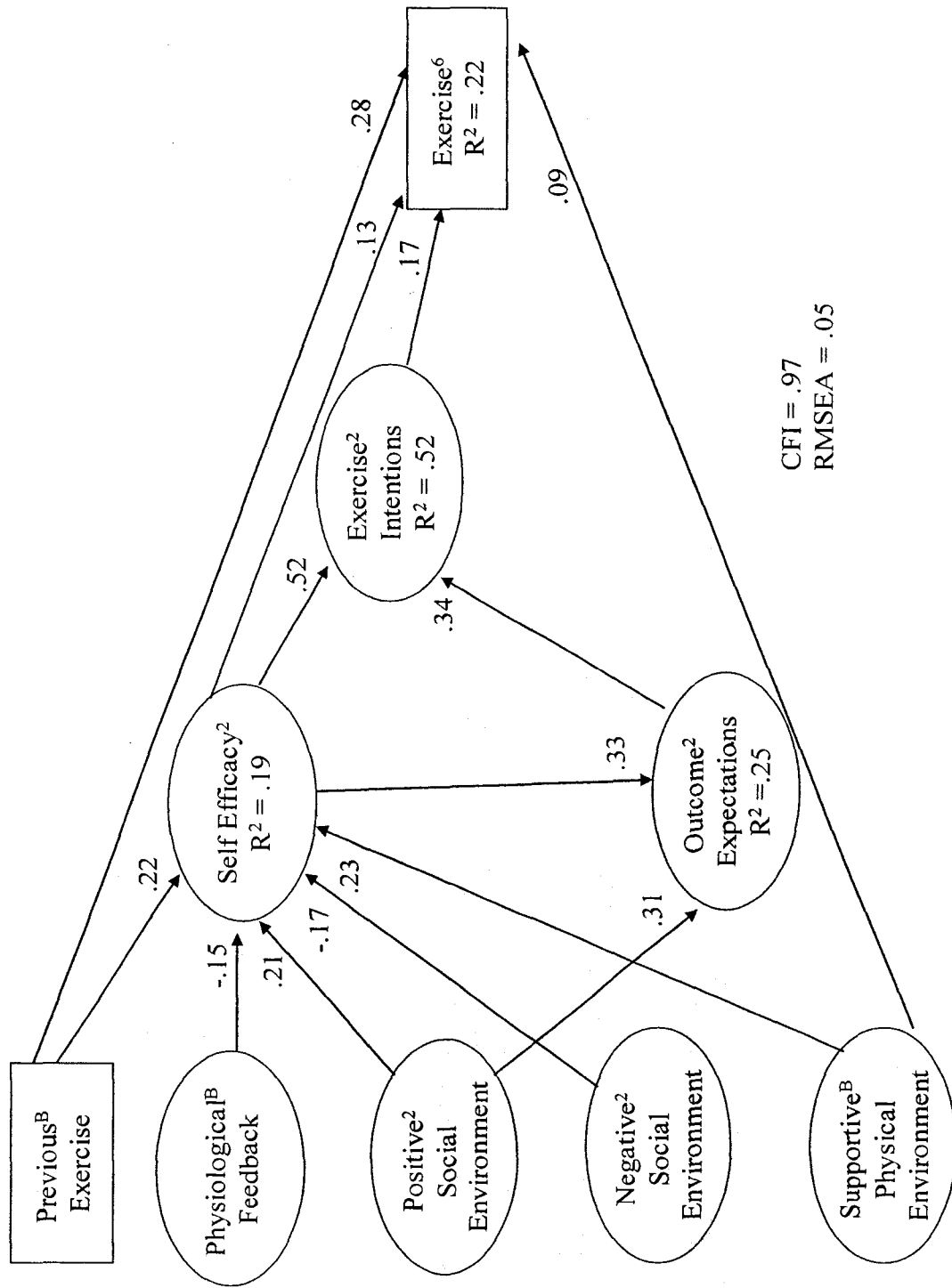


Figure 3. Resulting Model of Exercise Behavior at 6-Months Post-Hospitalization - Significant paths only (p≤.05)

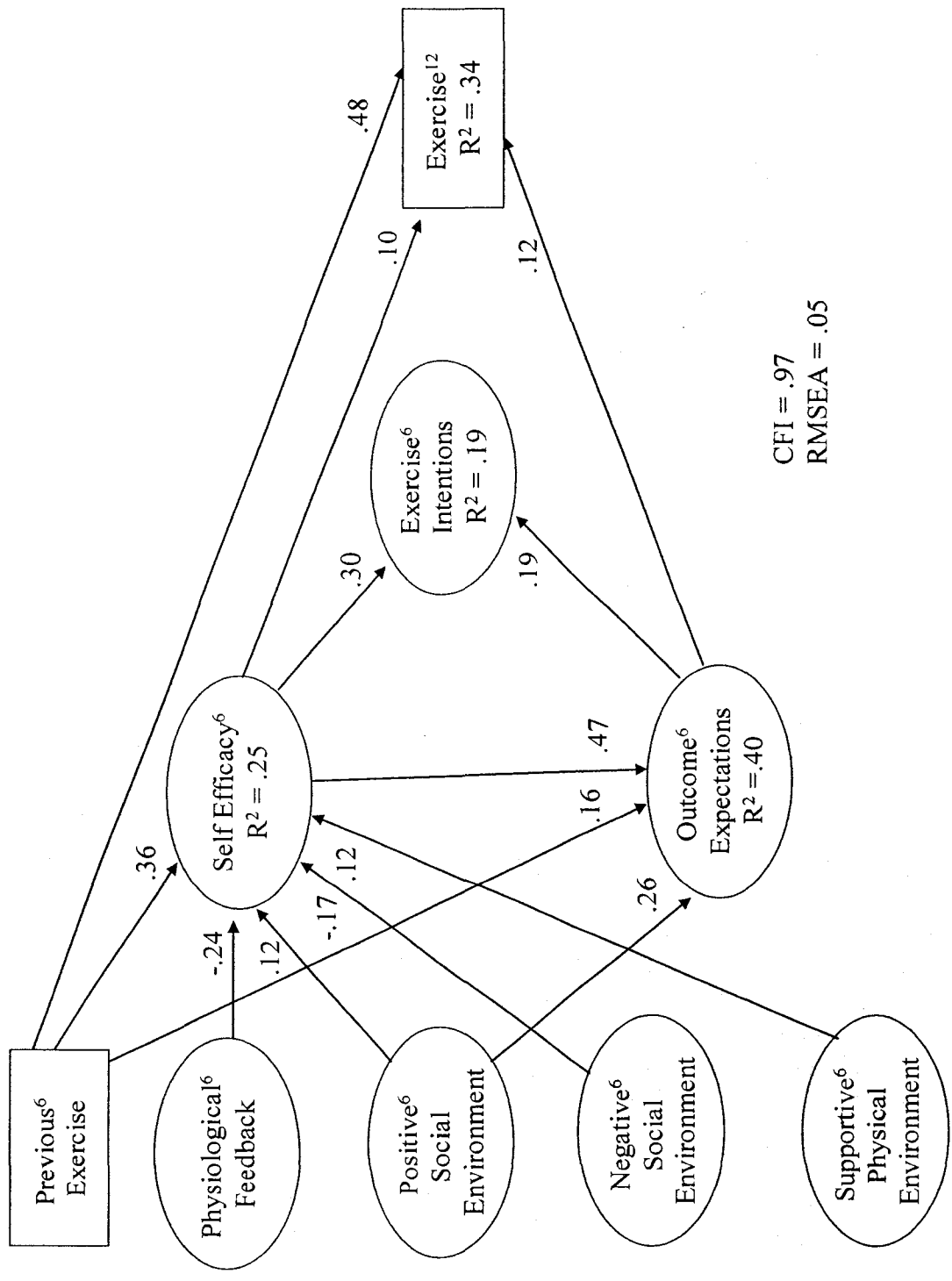


Figure 4. Resulting Model of Exercise Behavior 12-Months Post-Hospitalization – Significant paths only (p ≤ .05)

CHAPTER IV

SUPPLEMENTARY ANALYSES – FURTHER TESTING OF SOCIAL COGNITIVE THEORY'S CONCEPT OF RECIPROCAL DETERMINISM

INTRODUCTION

The majority of health behaviour change models focus on the factors affecting the adoption of healthy behaviours. Few models, however, address the determinants of behavioural maintenance (Rothman, 2000). Instead, it is assumed that the psychological variables involved in the activation of a new behaviour are also involved in the maintenance of that behaviour. However, this assumption has been questioned (Rothman, 2000; Rothman et al., 2004) based on the repeated findings that individuals that successfully adopt a healthy behaviour often fail to maintain the behaviour overtime (Burke et al., 1997; Dishman, 1994). Further, although many interventions have assisted individuals in the successful adoption of behaviour and delay the onset of relapse, they do not necessarily improve the long-term rates of behaviour engagement (Bull & Jamrozik, 1998).

Social cognitive theory (SCT) is one of the only health behaviour change models that address the adoption and maintenance of behaviour. Self-efficacy is posited to be a key determinant across both phases (Bandura, 1997). Bandura also argued that as people become more active, their skills improve and they find strategies or solutions to barriers encountered. As a result, their self-efficacy increases. This suggests that previous exercise should predict self-efficacy which, in turn, should predict exercise behaviour. This exercise behaviour is then expected to further enhance self-efficacy, and the cycle continues in this fashion. A similar trend is expected for outcome expectations.

Despite the above theoretical claim, no study has tested Bandura's concept of reciprocal determinism. In fact, the majority of studies investigating SCT have employed cross-sectional designs and few measure the variables of interest past 6 months follow-up (McAuley et al., 2003). Accordingly, the purpose of this supplementary chapter is to further test SCT's concept of

reciprocal determinism in the prediction of exercise behaviour over one year. In order to test this pattern, we examined a less complex SCT model which investigated the relationships between self-efficacy, outcome expectations, intentions and exercise behaviour over the 12-month period. The additional structural model tested is presented in Figure 1.

Based on SCT's reciprocal determinism, we hypothesized that engaging in exercise before being hospitalized for a cardiac problem would lead to higher self-efficacy and outcome expectations for exercise behaviour in the future. We anticipated that this increased self-efficacy and outcome expectations would predict both exercise intentions and behaviour. In addition, a direct relationship is expected between exercise intentions and behaviour. Further, when controlling for the previous levels in each of the SCT variables, we expected that exercise behaviour reported at six months would, again, lead to greater confidence to overcome barriers to exercise (i.e., self-efficacy) as well as expected benefits from engaged in exercise, and these latter variables would influence exercise intentions and behaviour. That is, as self-efficacy and outcome expectations rise, patients were expected to have higher intentions to be active as well as engage in more activity.

METHOD

The same methodology and questionnaires employed in the second article presented in this dissertation were used in this supplementary study. We also used data from the complete sample of 770 patients with coronary artery disease (CAD). Briefly, all participants were recruited from hospital and completed the questionnaires at baseline, 2, 6, and 12 months follow-up. We examined patients' scores for previous exercise, self-efficacy, outcome expectations, and exercise intentions and behaviour. Exercise behaviour at 6 months was predicted using the SCT variables measured at baseline and 2 months. Exercise behaviour at 12 months was predicted

using SCT variables measured at 6 months. In addition, as displayed in Figure 1, we controlled for previous levels of the SCT variables in the model. Structural equation modelling (SEM) was used to test the model of reciprocal determinism.

RESULTS

Social Cognitive Variables and Exercise Behaviour

Table 1 presents the participants' scores for the SCT predictors in the model. At baseline, participants were moderately confident in their ability to overcome barriers to participate in exercise and had fairly high expectations of the possible benefits of exercise. Significant changes in the scores on these variables were observed over time: both self-efficacy and outcome expectations increased significantly from baseline to 2 months, followed by a decline at 6 months ($p < .01$). Participants' self-reported exercise intentions increased significantly as time progressed from baseline to 2 months ($p = .03$), and then remained stable from 2 to 6 months ($p > .10$). Significant improvements in exercise behaviour were reported from baseline (i.e., previous exercise) to 6 months and 12 months ($p < .01$).

Model Testing

The resulting model is presented in Figure 2. Model estimation yielded an adequate fit (χ^2 ($df = 435$, $N = 770$) = 1582.8, $p < .001$; CFI = .91; RMSEA = .09). The variables in the model accounted for 19% and 33% of the variance in exercise behaviour at 6 and 12 months, respectively. As predicted, self-efficacy measured at 2 months was predicted by previous exercise measured at baseline. In turn, self-efficacy (2 months) predicted both exercise intentions (2 months) and exercise behaviour reported at 6 months. Then, exercise behaviour at 6 months predicted 6-month self-efficacy levels, but the direct link from self-efficacy to exercise behaviour reported at 12 months was insignificant. However, self-efficacy measured at 6 months influenced exercise

behaviour indirectly via outcome expectations. Although patients reported that their confidence to exercise despite barriers continued to be fairly high level, self-efficacy did not remain a significant direct predictor of exercise behaviour reported 12 months.

Previous exercise measured at baseline was not a significant predictor of 2-month outcome expectations. In addition, outcome expectations did not predict 6-month exercise levels directly but, instead operated indirectly through intentions. Interestingly, the hypothesized relationships regarding outcome expectations were observed in the second portion of the model. That is, outcome expectations measured at 6 months were predicted by activity over the last 6 months. In turn, outcome expectations had a direct impact on exercise behaviour reported at 12 months. Overall, the values reported for outcome expectations dropped significantly over time, but instead of observing a weakening in the outcome expectation-exercise behaviour relationship, it became stronger.

Finally, as predicted, exercise intentions measured at 2 months predicted exercise behaviour reported at 6 months. Contrary to hypotheses, this relationship was not observed in the latter part of the model predicting exercise at 12 months.

An examination of the total effects revealed that previous exercise was the most influential variable on exercise behaviour reported at 6 and 12 months ($\beta = .32$ and $.51$, respectively). At 6 months, self-efficacy was also a prominent predictor ($\beta = .24$), followed by exercise intentions ($\beta = .19$) and outcome expectations ($\beta = .08$). At 12 months, outcome expectations and self-efficacy measured at 6 months also had significant total effects on exercise behaviour ($\beta = .14$ and $.13$, respectively).

DISCUSSION

This supplementary chapter aimed to test the theoretical concept of reciprocal determinism applied to exercise behaviour reported by patients with heart disease during the year post-hospitalization. This is the first study to empirically evaluate this theoretical claim. In general, our findings partially support SCT. Specifically, SCT's progressive cycle between previous exercise, self-efficacy and future behaviour was supported in the short-term, but the final link between self-efficacy at 6 months and exercise behaviour reported at 12 months was not observed. Nonetheless, self-efficacy continued to contribute to behaviour at this point, albeit indirectly, but the strength of the relationship declined (total effects of self-efficacy: $\beta = .24$ at 6 months and $\beta = .13$ at 12 months). Despite the decline, self-efficacy and outcome expectations – which had a direct link to exercise at 12 months – were almost equivalent in their overall power to predict exercise 12 months post-hospitalization (i.e., $\beta = .14$ and $\beta = .13$, respectively).

One explanation for the reduction in predictive power of self-efficacy in the long-term is that scores on this scale fell slightly overtime. Bandura posited that participants' self-efficacy should increase with experience; however, our sample reported a slight decrease. If an additional increase in these scores were reported, the cycle may have continued. It is also possible that there is a ceiling effect for self-efficacy and, therefore, a continued increase in self-efficacy may not be reported which effects the link to behaviour. In addition, as previous levels of the self-efficacy scores were controlled for in the model and very little change was observed between the 2-month and 6-month scores (i.e., 0.1), the statistical analyses were conducted with a very small residual score – this likely minimized the role of self-efficacy in predicting exercise behaviour at 12 months. Also, other authors have hypothesized that self-efficacy is important for adoption a new behaviour pattern, but not behavioural maintenance. Instead, Rothman and colleagues (2000,

2004) suggested that perceived satisfaction in the outcomes received and enjoyment gained (i.e., intrinsic motivation) from engaging in activity may play larger roles in the maintenance of a behaviour.

The opposite relationships were observed within the model in regards to outcome expectations. Specifically, insignificant links were observed in the cyclical pattern between previous exercise, outcome expectations and future behaviour in the short term, but significant paths were found in the long-term. More precisely, previous exercise did not predict outcome expectations at 2 months, and the expectations were not directly linked to behaviour at 6 months. However, in the latter stages of the model, all paths between these variables were significant. This suggests that outcome expectations are less important for behaviour initiation, but may be more involved in behaviour maintenance.

Similar to article 2 and in line with SCT, exercise intentions were significantly and positively predicted by self-efficacy and outcome expectation in the early and latter stages of recovery. In addition, these intentions were directly associated with exercise behaviour in the short term, but not in the long-term. Possibly explanations for this finding are discussed in the previous chapter.

Finally, the results from the supplementary analyses suggest that personal experience with exercise behaviour is a strong determinant of future efficacy beliefs and exercise behaviour. In fact, this variable's influence increased over time with additional experience. This finding is consistent with SCT. Although interventions cannot modify participants' level of previous exercise, this information may be used to stratify patients within cardiac rehabilitation programs. Based on our results, patients with past experience with exercise will have higher levels of self-

efficacy and, therefore, may need less intensive interventions. This finding may have cost-saving implications for cardiac rehabilitation programs.

In conclusion, the variables in this model accounted for 19% and 33% of exercise behaviour at 6 and 12 months, respectively. Previous exercise was the most important predictor of exercise behaviour in the future. The only modifiable determinant directly influencing 12-month exercise behaviour was outcome expectations; however, self-efficacy also played a role indirectly. In this study, the concept of reciprocal determinism was partially supported; however, future research with longitudinal designs is needed.

Table 1. SCT Predictors and Exercise Behaviour Over Time

| Variable | <u>Baseline</u> | <u>2 months</u> | <u>6 months</u> |
|-----------------------|------------------------|------------------------|-------------------------|
| | M (SD) | M (SD) | M (SD) |
| Barrier Self-Efficacy | 4.3 (1.3) | 4.8 (1.3) | 4.7 (1.4) |
| Outcome Expectations | 5.3 (1.1) | 5.5 (1.1) | 4.6 (1.3) |
| Exercise Intentions | | | |
| One month | 5.0 (1.9) | 5.6 (1.7) | 5.5 (1.6) |
| Six months | 5.6 (1.6) | 5.8 (1.5) | 5.7 (1.5) |
| Weekly frequency | 3.9 (2.2) | 4.4 (1.9) | 4.3 (1.8) |
| | <u>Baseline</u> | <u>6 months</u> | <u>12 months</u> |
| Exercise Behaviour | 23.2 (20.5) | 35.4 (21.5) | 42.1 (30.3) |

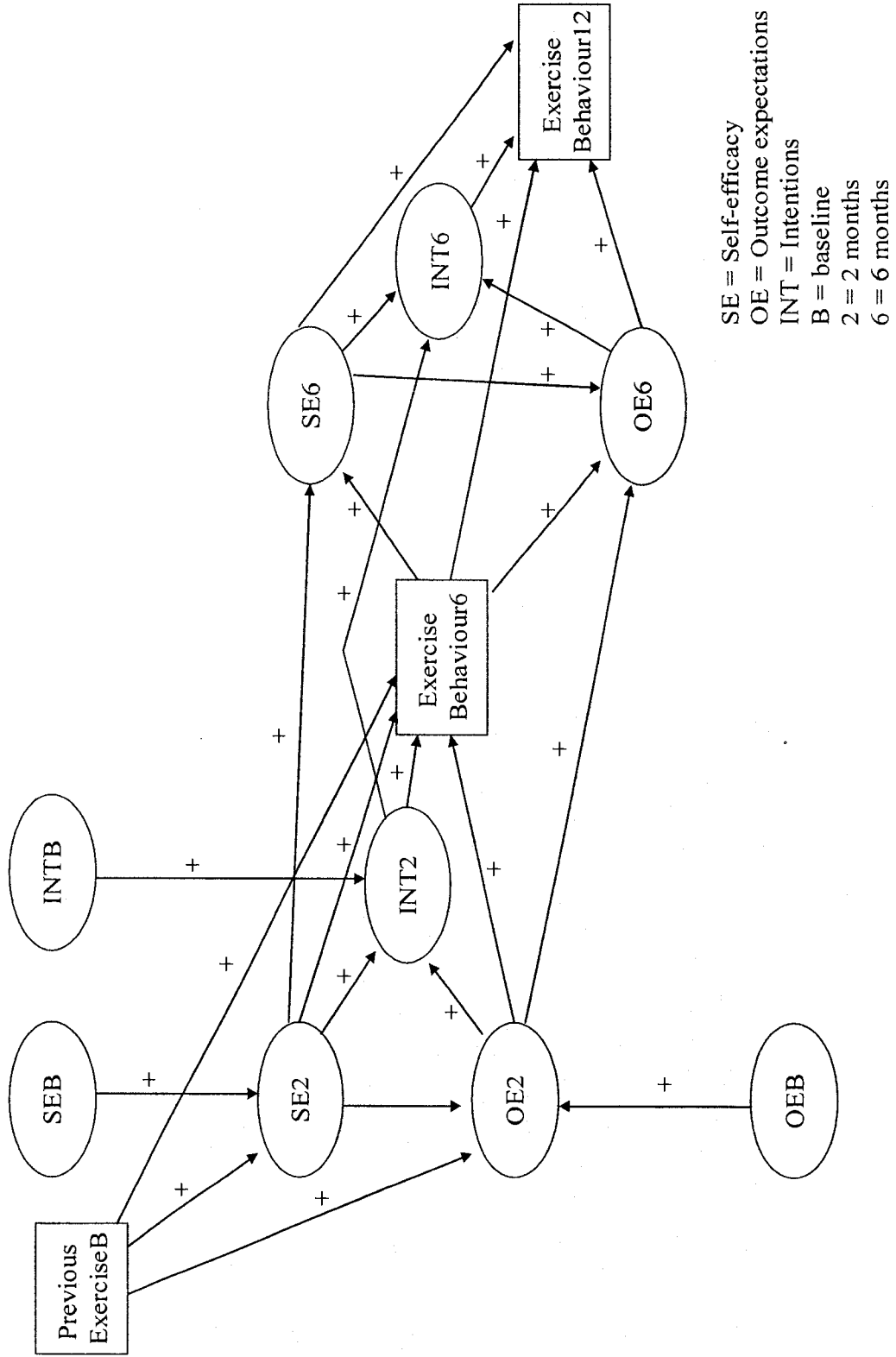


Figure 1. Testing SCT's Reciprocal Determinism – Hypothesized model

Note: Although significant, the relationships between the previous and current levels of the SCT variables are not included in this figure

SE = Self-efficacy
 OE = Outcome expectations
 INT = Intentions
 B = baseline
 2 = 2 months
 6 = 6 months
 12 = 12 months

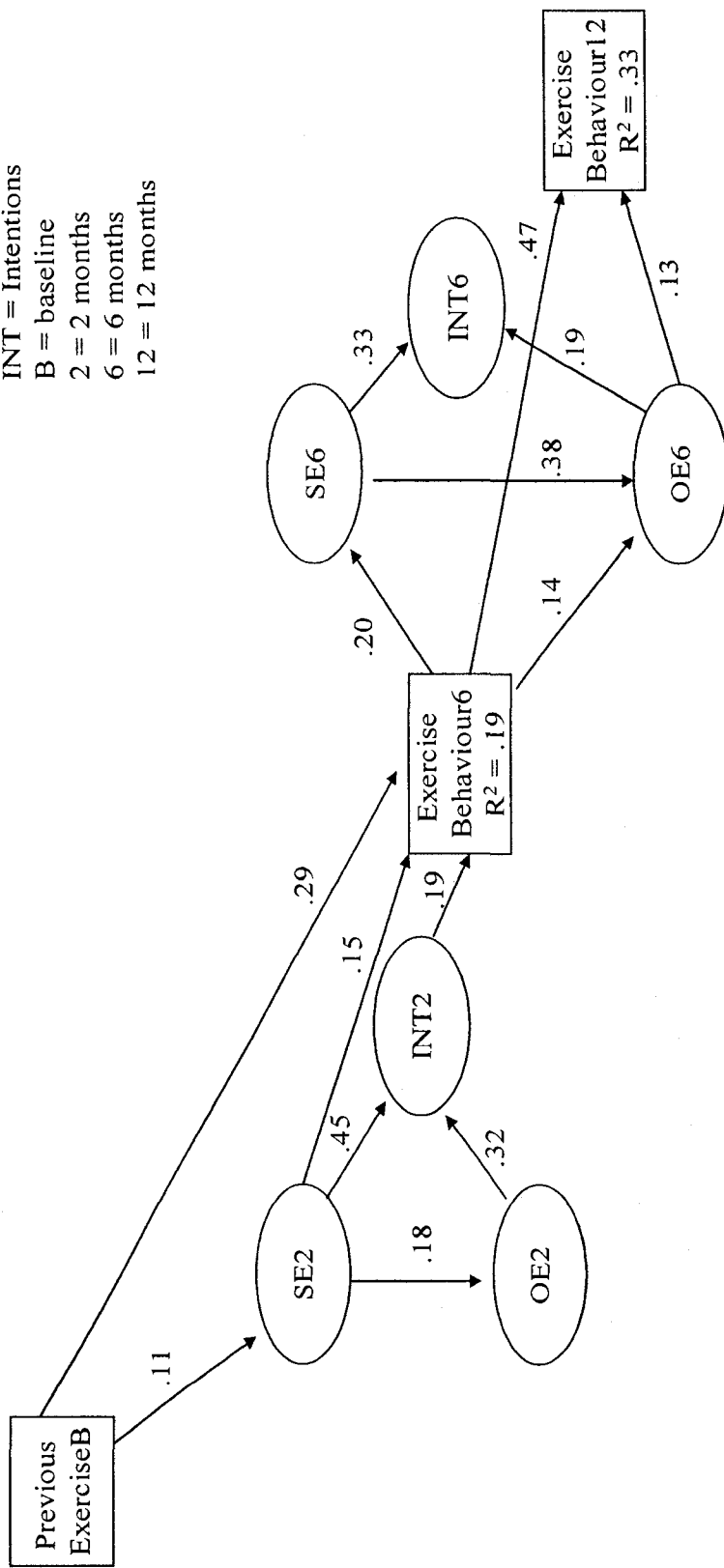


Figure 2. Testing SCT's Reciprocal Determinism - Resulting Model with Significant Paths ($p < .05$)

CHAPTER 5 - DISCUSSION

This dissertation examined the determinants of exercise intentions and behaviour over time in patients diagnosed with CAD using SCT as a theoretical framework. This was accomplished by conducting two empirical investigations. First, a pilot study using a cross-sectional design tested the SCT model in the prediction of exercise intentions. Second, a longitudinal study using a prospective design tested the SCT model predicting exercise behaviour at 6-months and 12-months post-hospitalization. The results of these investigations were presented in two journal articles. In the first article, "Testing a Social Cognitive Model of Exercise Intentions in Patients with Coronary Artery Disease," we sought to identify which SCT variables were most strongly associated with exercise intentions. Specifically, we examined relationships between previous exercise, social support for exercise, physical environmental variables, self-efficacy, outcome expectations, and exercise intentions as the outcome variable. Using SEM, results demonstrated that the model was a good representation of the relationships within the data. The SCT variables accounted for a large amount of variance (54%) in exercise intentions in patients with CAD. In this study, exercise intentions were mainly influenced by participant's efficacy beliefs, and moderately by their outcome expectations. Previous exercise, social support for exercise, and a supportive physical environment also contributed to patients' exercise intentions indirectly through self-efficacy and/or outcome expectations. As most theoretically hypothesized relationships were observed, this study provided support for the utility of SCT in the prediction of exercise intentions in individuals diagnosed with heart disease.

The second article, "Personal and Environmental Determinants of Exercise in Patients with Coronary Artery Disease: Evaluating a Social-Cognitive Model," used a longitudinal prospective design to better understand exercise behaviour in patients with CAD. Building from

the pilot study, this study tested a more comprehensive SCT model of exercise at two time points. We added more exercise determinants into the model and measured actual exercise behaviour rather than intentions. More precisely, we examined the relationships between previous exercise, physiological feedback, positive and negative social environments, supportive physical environments, self-efficacy, outcome expectations, exercise intentions and exercise behaviour 6-months (time 1) and one-year (time 2) after a cardiac-related hospitalization. Examining the two time-points allowed for a comparison of the exercise determinants in patients with CAD over time and, therefore, modifiable determinants may be targeted at the appropriate time. Again, the model was a good fit to the data, and accounted for 22% and 34% of the variance in the participants' exercise behaviour at 6-months and 12-months, respectively. Results showed that previous exercise (over the past 6 months) exerted the largest total effect on exercise behaviour at both time points, followed by self-efficacy. In addition, at time 1, supportive physical environments and exercise intentions had significant and direct links to exercise. Outcome expectations did not have a direct relationship with exercise; instead an indirect effect was exerted via exercise intentions. At time 2, self-efficacy and outcome expectations also had a significant impact on exercise behaviour. Physiological feedback, positive and negative social environments, and supportive physical environments predicted self-efficacy and/or outcome expectations, but none had direct relationships with exercise behaviour. Finally, supplementary analyses were completed to further test SCT's concept of reciprocal determinism. Specifically, we examined the relationship between key SCT variables (i.e., self-efficacy, outcome expectations, and intentions) and exercise behaviour across time from baseline to 12 months in one model. Results from this model were very similar to those in article 2. In fact, all of the significant relationships found in the test of the model at 6 and 12 months were also found in the

supplementary model, save the direct path from self-efficacy at 6 months to exercise behaviour reported at 12 months. Despite this insignificant path, the total effects showed that self-efficacy continues to have an impact on long-term exercise behaviour. However, in this model, the predictive strength of self-efficacy was lower and approximately equivalent to outcome expectations. Overall, the results of the two journal articles as well as the supplementary analyses were complimentary and suggest that SCT provides a useful framework in the prediction of exercise-related constructs in patients with heart disease. The strengths of the studies, theoretical and practical implications of the findings, study limitations, and suggestions for future research are discussed below.

Strengths of the Studies

This dissertation has several strengths. First, this project used a strong theoretical framework, namely SCT, to better understand exercise intentions and behaviour in patients with CAD. In fact, it is one of the first studies to explore a more comprehensive SCT model in this population. Accordingly, this study allowed for an examination of important SCT constructs underlying exercise intentions and behaviour, and the processes through which they work. More specifically, we provided evidence for essential sources of information for self-efficacy and outcome expectations. Despite theoretical claims regarding the influence of previous experience, physiological feedback, and environment factors on these personal variables, little effort has been applied to examining these relationships in past studies. Using our results, researchers may formulate more advanced models of exercise and develop new interventions guided by theory for this target population. Second, the studies presented in this dissertation are the first to investigate the impact of physical environmental factors on self-efficacy, outcome expectations, and exercise behaviour in patients with heart disease. Also, the inclusion of the negative social

environment is another innovative addition. These additional variables provide new information about the exercise determinants in patients with CAD. Third, we answered the call for research investigating exercise determinants over time (Marcus et al., 2000; Sallis, 2001). Using a longitudinal design in the second article and supplementary analyses, we were able to differentiate between exercise determinants in the early and latter stages of recovery from a cardiac-related hospitalization. This study adds to the paucity of studies making these temporal comparisons (Sallis et al., 1992). Fourth, as most exercise determinant research has been conducted with the general population, these studies extend research in this domain by examining exercise perceptions, intentions and behaviour in individuals encountering a life threatening illness. Moreover, our sample was large and included patients with various cardiac conditions and those not enrolled in cardiac rehabilitation programs. This is an improvement over studies using convenience samples of cardiac rehabilitation participants only. Fifth, unlike past exercise research that has relied on correlational or multiple regression analyses (Masse, Dassa, Giles-Corti & Motl, 2002), we employed structural equation modeling to test our conceptual model. The advantage of this method is that parameter estimates of the relationships between the variables are corrected for measurement error. In addition, the estimates are conducted simultaneously enabling indirect and direct comparisons of the relationships between multiple variables (Masse et al., 2002).

Theoretical Implications

From a theoretical perspective, the overall results generally supported the relationships postulated by SCT. As anticipated, self-efficacy and outcome expectations had an impact on the exercise intentions and behaviour of patients diagnosed with CAD. Specifically, the first article demonstrated that self-efficacy and outcome expectations predicted intentions. The second

article found that self-efficacy had a direct impact on exercise behaviour measured at 6 months, whereas the effect of outcome expectations was indirect. At 12 months, both self-efficacy and outcome expectations showed direct relationships with exercise. However, in the supplementary analyses, self-efficacy's relationship with exercise behaviour was indirect only. The positive association between self-efficacy and exercise has been demonstrated consistently in previous research with healthy adults (McAuley et al., 2003; McNeill et al., 2006; Stigglebout et al., 2006) and patients with heart disease (Blanchard, Courneya et al., 2002; Hellman, 1997; Woodgate et al., 2005). The role of outcome expectations has been less clear in past studies (Bennett et al., 1999; Rovniak et al., 2002). The present research helped clarify the role of outcome expectations. Specifically, our results indicate that outcome expectations are important when initiating behaviour as they influence exercise intentions which, in turn, have an impact on actual behaviour. However, as people gain experience with exercise over time, their perceived benefits play a more direct and influential role. Interestingly, outcome expectations dropped over time but their relationship to exercise became stronger. Perhaps people have unrealistic expectations initially, and their expectations are influenced by actual goals achieved over time or their satisfaction with the outcomes gained. Future studies measuring outcome expectations and the degree to which these expectations are met may provide further information. Finally, consistent with SCT (Bandura, 1997), self-efficacy showed a stronger relationship with exercise intentions and behaviour than did outcome expectations in both of our studies. This finding is also in accordance with previous research (Conn et al., 1998; Resnick, 2001b; Rovniak et al., 2002). However, in the supplementary analyses, self-efficacy and outcome expectations were equivalent in their overall predictive power.

Sources of Self-Efficacy and Outcome Expectations

Our studies also provide additional evidence regarding the sources of information for self-efficacy and outcome expectations. As postulated by SCT, all paths leading to self-efficacy were found to be significant in both studies. However, contrary to SCT (Bandura, 1997), previous exercise was not the strongest predictor in the formation of efficacy beliefs in each test of the model. Social support and supportive physical environments were slightly more influential in the pilot study and test of the model at 6 months, respectively. Higher behavioural achievements are said to have more influence on self-efficacy, therefore, we would expect a larger impact when higher levels of previous exercise are reported (Bandura, 1997). The mean level of previous exercise reported in the pilot study and test of the model at 6 months was lower than in the test of the model at 12 months. Interestingly, when the level of previous exercise was highest (i.e., at 12 months), the results were in line with theory. This implies that greater success in the exercise in the past enhances beliefs that one may successfully overcome barriers to re-engage in activity. In addition, the supplementary analyses supported this cyclical pattern between previous exercise and self-efficacy. Previous experience is often omitted from research; our studies added to the literature by examining this variable's relationship to exercise-related constructs and behaviour.

Further, our findings support Bandura's claim that self-efficacy is influenced by somatic symptoms in those of compromised health. Specifically, physiological feedback was inversely associated with self-efficacy suggesting that shortness of breath and angina symptoms undermine exercise confidence. Interestingly, this impact strengthened over time. Perhaps patients expect to experience these symptoms in the short-term following a cardiac event or procedure, but over time they expect the symptoms to diminish. If not, their confidence in their ability to exercise

declines. In a similar line, Resnick (2001a) investigated the relationship between positive physical health and exercise and revealed a positive relationship.

Turning to external sources, we found that a supportive physical environment was a significant predictor of self-efficacy in each test of the model. In fact, when initiating activity it appears to be the most influential factor predicting patients' confidence to overcome obstacles to exercise. Once more, our data provide support for SCT by demonstrating that facilitators such as access to exercise resources enhance efficacy beliefs. The examination of physical environmental variables on self-efficacy is novel in both healthy adults and cardiac populations and, therefore, extends research in the exercise domain.

Finally, a positive social environment was also found to be a significant predictor of self-efficacy in both studies. Again, these findings support SCT. Further, the results extend research by replicating the findings of this theoretical relationship demonstrated in the general population (McAuley et al., 2003; Rovniak et al., 2002) to patients with CAD. In addition, the second study adds to the paucity of literature regarding impediments in one's social environment (Chogahara, 1999). Although participants reported few negative interactions in their social environment, these encounters affected their confidence to exercise despite barriers. Consistent with SCT (Bandura, 1986), the results presented in the second article show that criticizing and inhibiting comments are associated with lower self-efficacy.

Fewer significant relationships were observed for outcome expectations. Although an association was identified, self-efficacy did not exert a significant impact on outcome expectations in the pilot study. However, with a larger sample, this relationship was observed. Indeed, self-efficacy exerted a substantial effect on outcome expectations when tested at 6 and 12-months. The results from the second article and supplementary analyses are in line with SCT

(Bandura, 1997) and previous research (Resnick et al., 2000; Rovniak et al., 2002). As SCT argues, our results indicate that confidence to exercise at a criterion level despite barriers predicts greater perceived benefits from the activity. Also, a positive social environment had an impact on participants' expected benefits of exercise. In fact, this construct had the strongest relationship with outcome expectations in the cross-sectional study, and held almost equivalent weight as self-efficacy in the model tested at 6 months. As posited by SCT, these results imply that encouraging comments regarding exercise promote higher perceived expectations for the activity, especially soon after a cardiac event. Our results add to the small number of studies that have examined the effects of social support for exercise on outcome expectations. Although less often studied than self-efficacy, the inclusion of this relationship is theoretically and empirically justified. Finally, in line with SCT, previous exercise was a significant predictor of outcome expectations in two of three tests of the model, and in the supplementary model investigating exercise behaviour from baseline to 12 months.

In summary, the variables proposed to influence self-efficacy and outcome expectations accounted for up to 25% and 40%, respectively. These figures varied in each test of the model; the largest amount of variance was explained in the model tested at 12 months. Two previous studies testing SCT models showed similar levels of explained variance in self-efficacy (Resnick et al., 2000; 2001a). Another study evaluating a social ecological model in healthy adults accounted for 46% of the variance in self-efficacy (McNeill et al., 2006). In addition to the social environment, these authors included intrinsic motivation in their model. This variable contributed significantly to self-efficacy. Another recent study examining exercise behaviour in patients with CAD also showed a strong link from autonomous (i.e., intrinsic) motivation to self-efficacy (Slovinec D'Angelo et al., in press). The addition of a motivation measure may add to

the explained variance in self-efficacy. Bandura also noted that physiological feedback may also include an emotional component. Indeed, previous research demonstrated that affect significantly predicts self-efficacy (McAuley et al., 2003; Resnick et al., 2000). Including affect in the model may decrease the amount of unexplained variance in self-efficacy. Further, we measured self-efficacy in relation to barriers. This definition implies that participants have confidence in their skills (i.e., task self-efficacy) as well as confidence to overcome obstacles to exercise (Bandura, 1997). Unfortunately, we did not have a complete measure of task self-efficacy in our study and, thus, do not know if this variable would augment the amount of variance accounted for in self-efficacy. However, Slovinec and colleagues (in press) measured a related variable, perceived competence, and found that it significantly predicted self-efficacy in patients with heart disease. Regarding outcome expectations, the variance explained in outcome expectations was comparable to one study (Resnick et al, 2000) and much higher than another (Resnick, 2001a). Additional measures evaluating enjoyment, outcome expectations met/satisfaction, and negative outcome expectations might lead to a greater amount of variance explained (e.g., Rovniak et al., 2002).

Direct Relationships with Exercise Behaviour

Many of the hypothesized direct links to exercise in the model were also observed. In the SCT model tested at 6-months, previous exercise, self-efficacy, supportive physical environments, and exercise intentions influenced behaviour directly, whereas only previous exercise, self-efficacy and outcome expectations predicted exercise at 12 months. However, in the supplementary analyses, self-efficacy did not have a direct link to exercise behaviour at 12 months. The majority of these findings are in accordance with SCT. In contrast, we did not reveal direct associations between the social environment and outcome expectations with

exercise at 6 months post-hospitalization. Further, none of the environmental variables had a direct link to exercise in the long term. Based on SCT, these results are perplexing as the core postulates of the model state that behaviour is affected by both personal and environmental variables (Bandura, 1986). Moreover, previous research has shown a consistent link between positive social environments and exercise in healthy adults (Booth et al., 2000; Trost et al., 2002; Wallace, 2000), but this connection has been less reliable in patients heart disease. Two other studies including patients with CAD found that social support did not predict exercise (Allison & Keller, 1999; Carlson et al., 2001), whereas another revealed a significant association (Moore et al., 2003). However, each sample was very small ($n < 81$) and included cardiac rehabilitation participants only. Our study included a large sample and many participants not enrolled in a rehabilitation program, but still the social environment did not have a direct link to behaviour. Our participants reported low levels of social support. Perhaps this level is sufficient to enhance self-efficacy and outcome expectations, but a greater amount of support is needed for actual behaviour to occur.

Previous research with healthy adults has shown a relationship between physical environmental variables and exercise behaviour (Bauman et al., 2002). As mentioned, the second article is the first study to examine the physical environment in relations to cardiac patients' exercise behaviour. As argued by SCT, our data suggest that a supportive environment in which patients have access to exercise resources is important when starting exercise after a cardiac event. However, the influence of these variables weakened over time.

Exercise intentions had a significant direct impact on behaviour at 6 months post-hospitalization. Intentions did not predict behaviour when the model was tested at 12 months in article 2 and in the supplementary model. These results were not anticipated. Yet, another recent

study with cardiac patients discovered the same results (Scholz et al., 2005). Although Bandura (2004) reported that goals are essentially intentions, it is possible that the measure of intentions used in our studies affected the results. Perhaps only basic goals (e.g., “I intend to exercise 3 times per week”) are required when initiating activity, but over time more detailed goals are necessary to maintain the behaviour. Our measure could not assess this change. After the start of our data collection, Rovniak and colleagues (2002) published a newly validated scale measuring goals for use in the SCT model. This measure included 10 items assessing goal setting, self-monitoring, and problem solving (e.g., “I usually set dates for achieving my goals). Possibly a more comprehensive measure such as this would have better predict exercise behaviour over time.

Finally, we had hypothesized that the relationships between the SCT variables and exercise would be the same over time. However, we found that the exercise determinants for patients with CAD changed in the year following hospitalization. When exercise was initiated soon after a cardiac event, both environmental and personal factors were influential. However, as time progressed, only personal factors predicted exercise directly. In fact, in the supplementary analyses, the only modifiable determinant directly influencing 12-month exercise levels was outcome expectations. It appears that environmental factors (e.g., physical resources) are necessary in the early stages of recovery; however, over time individuals become more self-regulated in their exercise behaviour. Our findings resemble the process of internalization as proposed by Deci & Ryan (1985). These researchers posit that behaviour is initially regulated by external factors (e.g., peer pressure) but, eventually, people engage in the behaviour for internal reasons (e.g., enjoyment).

Reciprocal Determinism

The results from the supplementary analyses suggest that personal experience with exercise behaviour is a strong determinant of future efficacy beliefs and exercise behaviour. In fact, this variable's influence increased over time with additional experience. This finding is consistent with SCT. However, despite increases in participants' confidence to exercise even when faced with barriers, this confidence is less of a determinant in long-term behaviour. Although it seems that these findings do not support Bandura's claim that self-efficacy is a key determinant in behaviour maintenance, an examination of the total effects shows that self-efficacy had an impact on participants' 12-month exercise behaviour, albeit indirectly.

Practical Implications

In addition to the theoretical implications, the overall results of this dissertation offer numerous avenues for exercise promotion in patients with CAD. The entire set of SCT predictors under study contributed either indirectly or directly to participants' exercise intentions and behaviour over time and, therefore, should be fostered. Considering that previous exercise had the largest total effect on current exercise at both time points, interventions that concentrate on mastery experience, that is, the successful performance of activity are called for. This may involve self-monitoring of small and realistic steps when initially increasing exercise levels in order to ensure success (Edwards, 2001). In addition, it may be worthwhile for intervention participants to be stratified by previous activity level. For example, people who are previously active likely have learned strategies to handle common exercise-barriers. Perhaps these individuals could be "fast-tracked" through interventions making programs more cost-effective.

The results of the model tested at 6 months indicate that participants are more active soon after a cardiac-related hospitalization if they encounter supportive physical environments and

have higher intentions for exercise. Practically speaking, our results suggests that strategies such as making people more aware of resources in their community (e.g., provide an information sheet that outlines exercise facilities in the participant's community) and providing basic resources to those in need (e.g., running shoes) should lead to improved self-efficacy and increased activity in patients with heart disease. In addition, the provision of a newsletter may be mailed to patients over time to alert patients to ongoing community exercise initiatives and resources (Elley et al., 2003; Goldstein et al., 1999).

As self-efficacy and outcome expectations played a role in exercise behaviour at both time points, interventions are likely more effective if these constructs are targeted. In fact, interventions targeting these variables have increased not only their levels but also exercise behaviour (Pinto et al., 2001; Norris et al., 2000). Our findings indicate that self-efficacy may be enhanced by previous exercise, positive social environments, and supportive physical environments, and hindered by somatic symptoms and negative social environments. Therefore, interventions for self-efficacy should focus on successful experiences, augmenting supportive social and physical environments, problem-solving to address barriers, while minimizing somatic symptoms and negative social environments. Strategies for increasing exercise success and supportive physical environments were discussed above. Another way to use past exercise in the enhancement of self-efficacy is to encourage patients to use self-talk (i.e., statements to oneself), reminding themselves of their success and abilities in overcoming barriers in the past ("I've done it before, I can do it again"; Zinsser, Bunker & Williams, 1998).

In regards to social environments, interventions for self-efficacy may be improved by including family members. For example, if significant others are included in education sessions they may obtain information regarding the cardiac care and recovery of their loved one, benefits

of activity (enhancing positive statements), and have their concerns addressed (minimizing inhibiting statements). In addition, teaching positive communication strategies to help increase patients' confidence may be useful, especially in the early stages of recovery. Indeed, a recent review reported that family interventions after a cardiac event are effective at improving self-efficacy in the patient (Van Horn et al., 2002). In addition, patients could be encouraged to create buddy systems or engaged in social activities with a physical component (e.g., ballroom dancing). Cardiac rehabilitation programs provide some of this social interaction, however, as noted previously, most eligible patients do not attend. Instead, patients could be taught to seek support for their exercise from family or friends, or suggest that significant others join them in the activity.

Future interventions might also investigate whether participants' perception of their somatic symptoms are realistic or exaggerated. For example, if somatic symptoms are inflated due to negative cognitions (e.g., fear), interventions could teach cognitive strategies to reinterpret somatic symptoms enabling participants to decrease fears and continue exercising. Once more, self-talk may be applied here. For example, statements such as "I can't catch my breath, I'm going to have another heart attack" may be replaced by "my heart is working hard, but that is natural when doing activity."

In order to further enhance patients' confidence to overcome barriers, patients may be provided with handouts listing common barriers and possible solutions. An individual worksheet may also be beneficial to allow for personal perceived barriers, with an opportunity for brainstorming solutions and identifying alternatives before problems arise (Dishman & Buckworth, 1996). For example, if participants identify low confidence in their ability to exercise when they have work commitments, they may organize an exercise schedule that fits

into their work day (e.g., during lunch hour). These preventive strategies may help patients learn to identify triggers associated with sedentary behaviour and be prepared to avoid or control these obstacles.

In our studies, outcome expectations were influenced by previous exercise, self-efficacy, and positive social environments. In addition to the strategies noted above, patients may also be given information regarding the benefits of exercise either in the form of handouts or educational sessions. Helping them to identify their personal reasons for exercising and target goals which address these reasons may be most influential.

Finally, our results also suggest that participants with higher exercise intentions immediately after their cardiac event are more likely to engage in the behaviour at 6 months follow-up. Therefore, assisting patients in identifying their intentions (e.g., the frequency of exercise intended each week) should improve activity levels. Taken a step further, patients may be taught goal-setting strategies such as applying acronyms like SMART (specific, measurable, acceptable, realistic, time frame) to make goals more tangible and attainable (Canadian Society for Exercise Physiology, 2003). In addition, an action plan that answers the question “how do I do it?” and guides the patient as to when (e.g., morning/evening), where (e.g., fitness facility, home, outdoors) and with whom (e.g., family, buddy, alone) may further assist in attaining these goals and increasing exercise levels (Laitakari & Asikainen, 1998).

Limitations

Some study limitations warrant attention. First, the pilot study employed a cross-sectional design. This design is not able to establish causality, which makes it difficult to confirm the model’s ability to predict future exercise intentions. However, a recent comparison in the exercise domain showed that results from cross-sectional and longitudinal designs are similar

(Rhodes & Plotnikoff, 2005). In addition, the pilot study was not able to examine actual exercise behaviour. Although intentions are linked to behaviour (Bauman et al., 2002; Plotnikoff & Higginbotham, 2002), exercise behaviour – not intentions – produce the health benefits. However, as previously noted, this was a pilot study in preparation for the longitudinal investigation. Second, the sample of participants in both studies was over-represented by educated non-smokers. Caution should be used when generalizing to other patients with CAD. Third, we used a self-reported measure for exercise. Although there is evidence that these measures are reliable and show comparable results (Brownson et al., 1994; Jacobs et al., 1993), an objective measure would have been desirable. Fourth, although our model was based in theory, other important factors may account for additional variance in the exercise predictors and behaviour. For example, as noted earlier, a qualitative motivation measure and exercise-related affect may supply incremental information for self-efficacy and exercise behaviour (McAuley et al., 2003; McNeill et al., 2006; Slovinec et al., 2006). Still, our model explained over 34% of the variance in exercise behaviour at 12 months, a threshold suggested by Baranowski (1998) that is high for psychosocial models and useful for intervention development.

Future Research

As mentioned previously, most exercise research using SCT has included only one or two components of the theory. Future research is called for that continues to examine the comprehensive SCT model in the prediction of exercise. Further, these investigations should include longitudinal prospective designs. As such, we may better understand modifiable determinants of exercise in various populations, identify important sources of self-efficacy and outcome expectations, and build appropriate interventions tailored for exercise adoption and maintenance. More specifically, considering that the studies presented in this dissertation are the

first to examine the impact of physical environmental variables on cardiac patients' self-efficacy, outcome expectations, and exercise behaviour, future studies are warranted. In addition, our measure of the physical environment assessed participants' perception of the exercise resources available to them, rather than actual resources available. Future studies would do well to compare actual and perceived environmental variables. If perceptions are much lower than perceived, intervention efforts may enhance participants' awareness of resources with the goal of increasing activity. Further, in hopes of enhancing self-efficacy and outcome expectations in patients, we suggested that future interventions for patients with CAD include family members. However, a systematic evaluation of the incremental effect (if present) of family involvement is needed. Finally, from a methodological perspective, follow-up research might examine more detailed measures of goals and include a qualitative motivation measure in the model.

Conclusions

In conclusion, this dissertation examined the determinants of exercise intentions and behaviour over time in individuals with CAD using SCT as a theoretical framework. The overall purpose was divided into two studies of which the results were presented in two journal articles. Together, these studies helped clarify the relations among SCT variables and exercise intentions and behaviour in patients with CAD. The results suggest that multiple personal and environmental variables impact cardiac patients' exercise intentions and behaviour. In our longitudinal study, we found that the factors predicting exercise in the early stages of recovery differ from those in the long-term. In the months immediately proceeding cardiac-care in hospital, modifiable factors to be addressed include self-efficacy, physical environmental variables, and intentions. As patients become more active over time, outcome expectations became more important. Future research that continues to assess the relative importance of

personal and environmental determinants as well as the mechanisms underlying exercise behaviour is needed. As such, new advanced theories and intervention models may be developed and evaluated.

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APPENDIX A
QUESTIONNAIRES – ARTICLE 1

DEMOGRAPHIC QUESTIONNAIRE

1. Please complete the following:

- a) today's date (month/day/year) _____
- b) date of birth _____
- b) weight _____ lbs
- c) height _____ feet/inches
- d) sex: male female

2. What is the highest level of schooling you have completed?

- No formal education
- Completed elementary
- Some high school
- Completed high school (12 years)
- Trade college
- Some college/university
- Completed college/university
- Completed post-graduate

3. What is your employment status?

- Working full-time
- Working part-time
- Retired
- Unemployed
- Presently on short-term disability
- Presently on long-term disability
- Presently not working, but planning to return
- Not/Never employed outside the home

4. People living in Canada come from many different cultural and racial backgrounds that may impact their physical activity habits. Please indicate the group that best describes your origin. If you are of mixed ethnicity, indicate the group that best describes your father's ethnic background.

- White (Caucasian)
- Chinese
- South Asian (e.g., East Indian, Pakistani, Sri Lankan, etc.)
- Black
- Filipino
- Latin American
- Southeast Asian (e.g., Cambodian, Indonesian, Laotian, Vietnamese, etc.)
- Arab
- West Asian
- Japanese
- Korean
- Aboriginal People of North America (North American Indian, Métis, Inuit/Eskimo)

5. What is your marital status?

- Single, never married
- Married
- Living common law
- Divorced/separated
- Widowed

6. Gross Yearly Household Income (\$)

- Less than 24,999
- 25,000-29,999
- 30,000-39,999
- 40,000-59,999
- 60,000-79,999
- 80,000 or more

7. How would you describe your smoking status?

- Never smoked (Life-long non-smoker)
- Smoker (even a puff over the last 14-days) (use 7-days as reference at F/U)
- Recently quit (i.e., in the last 6-months)
- Quit (i.e., more than 6-months ago)

GODIN LEISURE-TIME EXERCISE QUESTIONNAIRE

Considering a typical week in the last 6-months, how many times on average do you do the following kinds of leisure time physical activity for more than 15 minutes during your free time? Please write on each line the appropriate number of times you engaged in the different kinds of leisure time physical activity described in the table below. If you have not participated in any leisure time physical activity, please indicate this with a 0.

| Intensity of Physical Activity | Times per Week |
|--|----------------|
| <p>Mild Exercise → (Minimal effort, no perspiration)</p> <p><u>Examples:</u> yoga, easy walking, golf, etc.</p> | <p>_____</p> |
| <p>Moderate Exercise → (not exhausting, light perspiration)</p> <p><u>Examples:</u> brisk walking, leisure or recreational sports, etc.</p> | <p>_____</p> |
| <p>Strenuous Exercise → (heart beats rapidly, sweating)</p> <p><u>Examples:</u> running, jogging, aerobic dance, competitive sports (soccer, basketball, swimming, etc.).</p> | <p>_____</p> |

PHYSICAL ENVIRONMENT QUESTIONNAIRE

1. What exercise equipment, if any, do you own or have access to?

(Please consider only equipment that is in working condition and safe for you to use.)

| Equipment | Do you have access? | | |
|----------------------------------|-----------------------|---|-----------------------|
| | Yes | - | No |
| Treadmill | <input type="radio"/> | | <input type="radio"/> |
| Rowing Machine | <input type="radio"/> | | <input type="radio"/> |
| Stationary Bicycle | <input type="radio"/> | | <input type="radio"/> |
| Outdoor Bicycle | <input type="radio"/> | | <input type="radio"/> |
| Cross Country Ski Simulator | <input type="radio"/> | | <input type="radio"/> |
| Elliptical / Step machine | <input type="radio"/> | | <input type="radio"/> |
| Skis (downhill or cross country) | <input type="radio"/> | | <input type="radio"/> |
| Skates | <input type="radio"/> | | <input type="radio"/> |
| Weight training equipment | <input type="radio"/> | | <input type="radio"/> |
| Heart (or pulse) rate monitor | <input type="radio"/> | | <input type="radio"/> |
| Running / Walking Shoes | <input type="radio"/> | | <input type="radio"/> |
| Golf Clubs | <input type="radio"/> | | <input type="radio"/> |
| Home exercise video or books | <input type="radio"/> | | <input type="radio"/> |

2. Which of the following exercise facilities do you consider to be *convenient* for you to access? (Mark all those that apply even if you don't use them)

| Facilities | Convenient for me to access | | |
|-----------------------------------|-----------------------------|---|-----------------------|
| | Yes | - | No |
| Fitness Club | <input type="radio"/> | | <input type="radio"/> |
| Jogging / Walking path | <input type="radio"/> | | <input type="radio"/> |
| Bicycle path / Bicycle lane | <input type="radio"/> | | <input type="radio"/> |
| Swimming pool | <input type="radio"/> | | <input type="radio"/> |
| Racquet Club/courts (e.g. tennis) | <input type="radio"/> | | <input type="radio"/> |
| Aerobic Exercise Class | <input type="radio"/> | | <input type="radio"/> |
| Golf course | <input type="radio"/> | | <input type="radio"/> |
| In-door Shopping Mall | <input type="radio"/> | | <input type="radio"/> |
| Ski trails | <input type="radio"/> | | <input type="radio"/> |
| Skating rink | <input type="radio"/> | | <input type="radio"/> |
| Martial Arts Studio | <input type="radio"/> | | <input type="radio"/> |
| Curling Club | <input type="radio"/> | | <input type="radio"/> |

3. Which of the following are present in the neighbourhood around your home? Please mark all that apply.

- sidewalks
- heavy traffic
- hills
- streetlights
- enjoyable scenery
- sidewalks cleared of snow

SOCIAL SUPPORT

Please mark your answers once for family and once for friends for each of the following statements:

During the past 4-weeks my family or friends:

| | | <u>Never</u> | <u>Rarely</u> | <u>Sometimes</u> | <u>Often</u> | <u>Very Often</u> |
|---------------------------------------|----------|--------------|---------------|------------------|--------------|-------------------|
| 1. Exercised with me. | FAMILY: | 0 | 1 | 2 | 3 | 4 |
| | FRIENDS: | 0 | 1 | 2 | 3 | 4 |
| 2. Offered to exercise with me. | FAMILY: | 0 | 1 | 2 | 3 | 4 |
| | FRIENDS: | 0 | 1 | 2 | 3 | 4 |
| 3. Gave me encouragement to exercise. | FAMILY: | 0 | 1 | 2 | 3 | 4 |
| | FRIENDS: | 0 | 1 | 2 | 3 | 4 |

4. In the last 4-weeks my doctor or health care provider has encouraged me to exercise regularly.

Never Rarely Sometimes Often Very Often

SELF-EFFICACY

The following questions ask about your confidence in being physically active under various circumstances. Please indicate how confident you are that you will be able to engage in regular physical activity over the next 4 weeks even ...

a. When you have many demands at work or many home duties.

| | | | | | | |
|-------------------------|-----------------------|-----------------------|-------------------------|-----------------------|-----------------------|-------------------------|
| Not at all Confident | | | Moderately Confident | | | Completely Confident |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

b. When you are feeling depressed?

| | | | | | | |
|-------------------------|-----------------------|-----------------------|-------------------------|-----------------------|-----------------------|-------------------------|
| Not at all Confident | | | Moderately Confident | | | Completely Confident |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

c. When you are feeling anxious or stressed?

| | | | | | | |
|-------------------------|-----------------------|-----------------------|-------------------------|-----------------------|-----------------------|-------------------------|
| Not at all Confident | | | Moderately Confident | | | Completely Confident |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

d. When you become bored with the activities?

| | | | | | | |
|-------------------------|-----------------------|-----------------------|-------------------------|-----------------------|-----------------------|-------------------------|
| Not at all Confident | | | Moderately Confident | | | Completely Confident |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

e. If you cannot notice improvements in your fitness?

| | | | | | | |
|-------------------------|-----------------------|-----------------------|-------------------------|-----------------------|-----------------------|-------------------------|
| Not at all Confident | | | Moderately Confident | | | Completely Confident |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

f. When you feel a little tired?

| | | | | | | |
|-------------------------|-----------------------|-----------------------|-------------------------|-----------------------|-----------------------|-------------------------|
| Not at all Confident | | | Moderately Confident | | | Completely Confident |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

g. After recovering from illness (e.g., flu, heart condition) or injury that caused you to stop exercising?

| | | | | | | |
|-------------------------|-----------------------|-----------------------|-------------------------|-----------------------|-----------------------|-------------------------|
| Not at all Confident | | | Moderately Confident | | | Completely Confident |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

h. When you feel physical discomfort when you exercise?

| | | | | | | |
|-------------------------|-----------------------|-----------------------|-------------------------|-----------------------|-----------------------|-------------------------|
| Not at all Confident | | | Moderately Confident | | | Completely Confident |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

i. During bad/uncomfortable weather (e.g., rain, snow, humidity)?

| | | | | | | |
|-------------------------|-----------------------|-----------------------|-------------------------|-----------------------|-----------------------|-------------------------|
| Not at all Confident | | | Moderately Confident | | | Completely Confident |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

j. If you have to do it by yourself?

| | | | | | | |
|-------------------------|-----------------------|-----------------------|-------------------------|-----------------------|-----------------------|-------------------------|
| Not at all Confident | | | Moderately Confident | | | Completely Confident |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

k. When there are other more interesting things to do?

| | | | | | | |
|-------------------------|-----------------------|-----------------------|-------------------------|-----------------------|-----------------------|-------------------------|
| Not at all Confident | | | Moderately Confident | | | Completely Confident |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

l. Without support from family or friends?

| | | | | | | |
|-------------------------|-----------------------|-----------------------|-------------------------|-----------------------|-----------------------|-------------------------|
| Not at all Confident | | | Moderately Confident | | | Completely Confident |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

OUTCOME EXPECTATIONS QUESTIONNAIRE

A major Benefit of Physical Activity for me is ...

| | Do Not | | Moderately | | | | |
|---|-------------------|---------------------|-------------------|----|----|----|----|
| | Completely | Agree at All | Agree | | | | |
| 1. Cope with life's pressures. | 1○ | 2○ | 3○ | 4○ | 5○ | 6○ | 7○ |
| 2. Improved health. | 1○ | 2○ | 3○ | 4○ | 5○ | 6○ | 7○ |
| 3. Release of tension. | 1○ | 2○ | 3○ | 4○ | 5○ | 6○ | 7○ |
| 4. Fun and enjoyment. | 1○ | 2○ | 3○ | 4○ | 5○ | 6○ | 7○ |
| 5. Improved mental alertness. | 1○ | 2○ | 3○ | 4○ | 5○ | 6○ | 7○ |
| 6. Maintain or lose weight. | 1○ | 2○ | 3○ | 4○ | 5○ | 6○ | 7○ |
| 7. Positive psychological effect. | 1○ | 2○ | 3○ | 4○ | 5○ | 6○ | 7○ |
| 8. Time spent with close friends and family members. | 1○ | 2○ | 3○ | 4○ | 5○ | 6○ | 7○ |
| 9. Sense of accomplishment. | 1○ | 2○ | 3○ | 4○ | 5○ | 6○ | 7○ |
| 10. Enhancing self-image and appearance. | 1○ | 2○ | 3○ | 4○ | 5○ | 6○ | 7○ |
| 11. Reduced risk of further heart problems. | 1○ | 2○ | 3○ | 4○ | 5○ | 6○ | 7○ |

EXERCISE INTENTIONS

For the next section of questions the following definition will be used when referring to regular physical activity / regular exercise.

Regular Physical Activity (Exercise) = 30 minutes or more of physical activity at a moderate-intensity or greater (e.g. intensity of a brisk walk or faster) 4 or more days per week.

1. Please state how much you agree with the following statements.

a) I intend to exercise regularly over the next month

Do not Agree
At All
1 2 3 4 5 6 7 Completely Agree

b) I intend to exercise regularly over the next six months

Do not Agree
At All
1 2 3 4 5 6 7 Completely Agree

1. Please complete the following sentence.

I intend to exercise 30 minutes or more at moderate intensity
next month.

- | |
|------------------------------|
| <input type="checkbox"/> 0 |
| <input type="checkbox"/> 1 |
| <input type="checkbox"/> 2 |
| <input type="checkbox"/> 3 |
| <input type="checkbox"/> 4 |
| <input type="checkbox"/> 5 |
| <input type="checkbox"/> 6 |
| <input type="checkbox"/> ≥ 7 |

times per week over the

APPENDIX B
QUESTIONNAIRES – ARTICLE 2

6. Gross Yearly Household Income (\$)

- Less than 24,999
- 25,000-29,999
- 30,000-39,999
- 40,000-59,999
- 60,000-79,999
- 80,000 or more

7. How would you describe your smoking status?

- Never smoked (Life-long non-smoker)
- Smoker (even a puff over the last 14-days) (use 7-days as reference at F/U)
- Recently quit (i.e., in the last 6-months)
- Quit (i.e., more than 6-months ago)

CARDIOVASCULAR MEDICAL HISTORY
(includes physiological feedback)

1. Was this your first hospital admission for a heart problem?

- Yes, skip to question 2
 No

If No, List other cardiac related hospitalizations;

| Hospitalized for; | Yes | No | Year(s) of event(s) |
|---------------------------------|-----------------------|-----------------------|------------------------|
| Heart Attack | <input type="radio"/> | <input type="radio"/> | |
| Bypass Surgery | <input type="radio"/> | <input type="radio"/> | |
| Angioplasty (balloon procedure) | <input type="radio"/> | <input type="radio"/> | |
| Heart Failure | <input type="radio"/> | <input type="radio"/> | |
| Chest Pain (Angina) | <input type="radio"/> | <input type="radio"/> | |
| Other (specify); | <input type="radio"/> | <input type="radio"/> | |

2. Please indicate which of the following medical conditions you have and if they are currently limiting your physical activity.

| Conditions | Yes, I have... | To what extent does this condition limit your physical activity? | | | |
|----------------------------------|-----------------------|---|-----------------------|-----------------------|-----------------------|
| | | Not at all | Mildly | Moderately | Severely |
| Lung Disease | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Arthritis | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Diabetes | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Stroke | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Cancer | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Poor circulation to your legs | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Back pain, leg pain | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Shortness of breath | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Angina or chest tightness | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| Other (Specify:) | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

PHYSICAL ENVIRONMENT QUESTIONNAIRE

**1. What exercise equipment, if any, do you own or have access to?
(Please consider only equipment that is in working condition and safe for you to use.)**

| Equipment | Do you have access? | | |
|----------------------------------|-----------------------|---|-----------------------|
| | Yes | - | No |
| Treadmill | <input type="radio"/> | | <input type="radio"/> |
| Rowing Machine | <input type="radio"/> | | <input type="radio"/> |
| Stationary Bicycle | <input type="radio"/> | | <input type="radio"/> |
| Outdoor Bicycle | <input type="radio"/> | | <input type="radio"/> |
| Cross Country Ski Simulator | <input type="radio"/> | | <input type="radio"/> |
| Eliptical / Step machine | <input type="radio"/> | | <input type="radio"/> |
| Skis (downhill or cross country) | <input type="radio"/> | | <input type="radio"/> |
| Skates | <input type="radio"/> | | <input type="radio"/> |
| Weight training equipment | <input type="radio"/> | | <input type="radio"/> |
| Heart (or pulse) rate monitor | <input type="radio"/> | | <input type="radio"/> |
| Running / Walking Shoes | <input type="radio"/> | | <input type="radio"/> |
| Golf Clubs | <input type="radio"/> | | <input type="radio"/> |
| Home exercise video or books | <input type="radio"/> | | <input type="radio"/> |

2. Which of the following exercise facilities do you consider to be *convenient* for you to access? (Mark all those that apply even if you don't use them)

| Facilities | Convenient for me to access | | |
|-----------------------------------|-----------------------------|---|-----------------------|
| | Yes | - | No |
| Fitness Club | <input type="radio"/> | | <input type="radio"/> |
| Jogging / Walking path | <input type="radio"/> | | <input type="radio"/> |
| Bicycle path / Bicycle lane | <input type="radio"/> | | <input type="radio"/> |
| Swimming pool | <input type="radio"/> | | <input type="radio"/> |
| Racquet Club/courts (e.g. tennis) | <input type="radio"/> | | <input type="radio"/> |
| Aerobic Exercise Class | <input type="radio"/> | | <input type="radio"/> |
| Golf course | <input type="radio"/> | | <input type="radio"/> |
| In-door Shopping Mall | <input type="radio"/> | | <input type="radio"/> |
| Ski trails | <input type="radio"/> | | <input type="radio"/> |
| Skating rink | <input type="radio"/> | | <input type="radio"/> |
| Martial Arts Studio | <input type="radio"/> | | <input type="radio"/> |
| Curling Club | <input type="radio"/> | | <input type="radio"/> |

SOCIAL ENVIRONMENT QUESTIONNAIRE

During the past month, how often have your **FAMILY** (e.g., partner, siblings, other relatives), **FRIENDS** (e.g., friend, acquaintance, co-worker, neighbour), or **EXPERTS** (e.g., physician, nurse, physical therapist, exercise/sport instructor)...

Positive Items

| | <u>Never</u> | <u>Rarely</u> | <u>Sometimes</u> | <u>Often</u> | <u>Very Often</u> |
|---|--------------|---------------|------------------|--------------|-------------------|
| 1. Offered to participate in physical activity with you. | | | | | |
| FAMILY: | 0 | 1 | 2 | 3 | 4 |
| FRIENDS: | 0 | 1 | 2 | 3 | 4 |
| 2. Informed you about the expected positive effects of physical activity. | | | | | |
| FAMILY: | 0 | 1 | 2 | 3 | 4 |
| FRIENDS: | 0 | 1 | 2 | 3 | 4 |
| EXPERT: | 0 | 1 | 2 | 3 | 4 |
| 3. Complimented you on the mastery of a physical activity skill. | | | | | |
| FAMILY: | 0 | 1 | 2 | 3 | 4 |
| FRIENDS: | 0 | 1 | 2 | 3 | 4 |
| EXPERT: | 0 | 1 | 2 | 3 | 4 |
| 4. Given you helpful reminders to do physical activity with them. | | | | | |
| FAMILY: | 0 | 1 | 2 | 3 | 4 |
| FRIENDS: | 0 | 1 | 2 | 3 | 4 |
| 5. Clarified for you how you may achieve your health goals through physical activity. | | | | | |
| FAMILY: | 0 | 1 | 2 | 3 | 4 |
| FRIENDS: | 0 | 1 | 2 | 3 | 4 |
| EXPERT: | 0 | 1 | 2 | 3 | 4 |
| 6. Told you that you should be proud of your physical activity skills. | | | | | |
| FAMILY: | 0 | 1 | 2 | 3 | 4 |
| FRIENDS: | 0 | 1 | 2 | 3 | 4 |
| EXPERT: | 0 | 1 | 2 | 3 | 4 |
| 7. Changed their schedule so you could do physical activity with them. | | | | | |
| FAMILY: | 0 | 1 | 2 | 3 | 4 |
| FRIENDS: | 0 | 1 | 2 | 3 | 4 |
| 8. Explained to you why physical activity is important to your health. | | | | | |
| FAMILY: | 0 | 1 | 2 | 3 | 4 |
| FRIENDS: | 0 | 1 | 2 | 3 | 4 |
| EXPERT: | 0 | 1 | 2 | 3 | 4 |

Negative Items

| | <u>Never</u> | <u>Rarely</u> | <u>Sometimes</u> | <u>Often</u> | <u>Very Often</u> |
|--|---------------------|----------------------|-------------------------|---------------------|--------------------------|
| 1. Criticized your low skill level in physical activity. | | | | | |
| FAMILY: | 0 | 1 | 2 | 3 | 4 |
| FRIENDS: | 0 | 1 | 2 | 3 | 4 |
| EXPERT: | 0 | 1 | 2 | 3 | 4 |
| 2. Complained that physical activity took time away from them. | | | | | |
| FAMILY: | 0 | 1 | 2 | 3 | 4 |
| FRIENDS: | 0 | 1 | 2 | 3 | 4 |
| 3. Advised you to avoid physical activity in order to avoid injury or ill health. | | | | | |
| FAMILY: | 0 | 1 | 2 | 3 | 4 |
| FRIENDS: | 0 | 1 | 2 | 3 | 4 |
| EXPERT: | 0 | 1 | 2 | 3 | 4 |
| 4. Suggested that you avoid physical activity because of the potential health risks. | | | | | |
| FAMILY: | 0 | 1 | 2 | 3 | 4 |
| FRIENDS: | 0 | 1 | 2 | 3 | 4 |
| EXPERT: | 0 | 1 | 2 | 3 | 4 |

SELF-EFFICACY

The following questions ask about your confidence in being physically active under various circumstances. Please indicate how confident you are that you will be able to engage in regular physical activity over the next 4 weeks even ...

a. When you have many demands at work or many home duties.

| | | | | | | |
|-------------------------|-----------------------|-----------------------|-------------------------|-----------------------|-----------------------|-------------------------|
| Not at all Confident | | | Moderately Confident | | | Completely Confident |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

b. When you are feeling depressed?

| | | | | | | |
|-------------------------|-----------------------|-----------------------|-------------------------|-----------------------|-----------------------|-------------------------|
| Not at all Confident | | | Moderately Confident | | | Completely Confident |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

c. When you are feeling anxious or stressed?

| | | | | | | |
|-------------------------|-----------------------|-----------------------|-------------------------|-----------------------|-----------------------|-------------------------|
| Not at all Confident | | | Moderately Confident | | | Completely Confident |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

d. When you become bored with the activities?

| | | | | | | |
|-------------------------|-----------------------|-----------------------|-------------------------|-----------------------|-----------------------|-------------------------|
| Not at all Confident | | | Moderately Confident | | | Completely Confident |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

e. If you cannot notice improvements in your fitness?

| | | | | | | |
|-------------------------|-----------------------|-----------------------|-------------------------|-----------------------|-----------------------|-------------------------|
| Not at all Confident | | | Moderately Confident | | | Completely Confident |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

f. When you feel a little tired?

| | | | | | | |
|-------------------------|-----------------------|-----------------------|-------------------------|-----------------------|-----------------------|-------------------------|
| Not at all Confident | | | Moderately Confident | | | Completely Confident |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

g. After recovering from illness (e.g., flu, heart condition) or injury that caused you to stop exercising?

| | | | | | | |
|-------------------------|-----------------------|-----------------------|-------------------------|-----------------------|-----------------------|-------------------------|
| Not at all Confident | | | Moderately Confident | | | Completely Confident |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

h. When you feel physical discomfort when you exercise?

| | | | | | | |
|-------------------------|-----------------------|-----------------------|-------------------------|-----------------------|-----------------------|-------------------------|
| Not at all Confident | | | Moderately Confident | | | Completely Confident |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

i. During bad/uncomfortable weather (e.g., rain, snow, humidity)?

| | | | | | | |
|-------------------------|-----------------------|-----------------------|-------------------------|-----------------------|-----------------------|-------------------------|
| Not at all Confident | | | Moderately Confident | | | Completely Confident |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

j. If you have to do it by yourself?

| | | | | | | |
|-------------------------|-----------------------|-----------------------|-------------------------|-----------------------|-----------------------|-------------------------|
| Not at all Confident | | | Moderately Confident | | | Completely Confident |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

k. When there are other more interesting things to do?

| | | | | | | |
|-------------------------|-----------------------|-----------------------|-------------------------|-----------------------|-----------------------|-------------------------|
| Not at all Confident | | | Moderately Confident | | | Completely Confident |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

l. Without support from family or friends?

| | | | | | | |
|-------------------------|-----------------------|-----------------------|-------------------------|-----------------------|-----------------------|-------------------------|
| Not at all Confident | | | Moderately Confident | | | Completely Confident |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

OUTCOME EXPECTATIONS QUESTIONNAIRE

A major Benefit of Physical Activity for me is ...

| | Do Not | | Moderately | | | | |
|---|-------------------|---------------------|-------------------|--------------|----|----|--------------|
| | Completely | Agree at All | | Agree | | | Agree |
| 2. Cope with life's pressures. | 1○ | 2○ | 3○ | 4○ | 5○ | 6○ | 7○ |
| 3. Improved health. | 1○ | 2○ | 3○ | 4○ | 5○ | 6○ | 7○ |
| 4. Release of tension. | 1○ | 2○ | 3○ | 4○ | 5○ | 6○ | 7○ |
| 5. Fun and enjoyment. | 1○ | 2○ | 3○ | 4○ | 5○ | 6○ | 7○ |
| 6. Improved mental alertness. | 1○ | 2○ | 3○ | 4○ | 5○ | 6○ | 7○ |
| 7. Maintain or lose weight. | 1○ | 2○ | 3○ | 4○ | 5○ | 6○ | 7○ |
| 8. Positive psychological effect. | 1○ | 2○ | 3○ | 4○ | 5○ | 6○ | 7○ |
| 9. Time spent with close friends and family members. | 1○ | 2○ | 3○ | 4○ | 5○ | 6○ | 7○ |
| 10. Sense of accomplishment. | 1○ | 2○ | 3○ | 4○ | 5○ | 6○ | 7○ |
| 11. Enhancing self-image and appearance. | 1○ | 2○ | 3○ | 4○ | 5○ | 6○ | 7○ |
| 12. Reduced risk of further heart problems. | 1○ | 2○ | 3○ | 4○ | 5○ | 6○ | 7○ |

EXERCISE INTENTIONS

For the next section of questions the following definition will be used when referring to regular physical activity / regular exercise.

Regular Physical Activity (Exercise) = 30 minutes or more of physical activity at a moderate-intensity or greater (e.g. intensity of a brisk walk or faster) 4 or more days per week.

1. Please state how much you agree with the following statements.

a) I intend to exercise regularly over the next month

| | | | | | | | |
|------------------------|----|----|----|----|----|----|---------------------|
| Do not Agree At All | | | | | | | Completely Agree |
| 1○ | 2○ | 3○ | 4○ | 5○ | 6○ | 7○ | |

b) I intend to exercise regularly over the next six months

| | | | | | | | |
|------------------------|----|----|----|----|----|----|---------------------|
| Do not Agree At All | | | | | | | Completely Agree |
| 1○ | 2○ | 3○ | 4○ | 5○ | 6○ | 7○ | |

1. Please complete the following sentence.

I intend to exercise 30 minutes or more at moderate intensity next month.

- | |
|------------------------------|
| <input type="checkbox"/> 0 |
| <input type="checkbox"/> 1 |
| <input type="checkbox"/> 2 |
| <input type="checkbox"/> 3 |
| <input type="checkbox"/> 4 |
| <input type="checkbox"/> 5 |
| <input type="checkbox"/> 6 |
| <input type="checkbox"/> ≥ 7 |

times per week over the

GODIN LEISURE-TIME EXERCISE QUESTIONNAIRE

Considering a typical week in the last 6-months, how many times on average do you do the following kinds of leisure time physical activity for more than 15 minutes during your free time? Please write on each line the appropriate number of times you engaged in the different kinds of leisure time physical activity described in the table below. If you have not participated in any leisure time physical activity, please indicate this with a 0.

| Intensity of Physical Activity | Times per Week |
|--|----------------|
| <p>Mild Exercise → (Minimal effort, no perspiration)</p> <p>Examples: yoga, easy walking, golf, etc.</p> | <p>_____</p> |
| <p>Moderate Exercise → (not exhausting, light perspiration)</p> <p>Examples: brisk walking, leisure or recreational sports, etc.</p> | <p>_____</p> |
| <p>Strenuous Exercise → (heart beats rapidly, sweating)</p> <p>Examples: running, jogging, aerobic dance, competitive sports (soccer, basketball, swimming, etc.).</p> | <p>_____</p> |