

Financial Health Incentives in Cardiac Rehabilitation

by

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Abstract

Financial health incentives, such as paying people to exercise, are being widely implemented despite limited evidence of their effectiveness. Accordingly, the objectives of this work were to (1) examine the efficacy of incentives-for-exercise in adults, (2) determine the potential for incentives to promote *long-term* exercise adherence (> 6 mo.) and (3) to explore incentive ‘acceptability’ and efficacy in cardiac rehabilitation (CR). A comprehensive CR outpatient program designed to help individuals recover from and manage their cardiovascular disease (CVD) was a suitable initial target for incentives in Canadian health care since many CVD risk factors are under behavioural control (e.g., physical inactivity). To determine the impact of incentives on exercise adherence in adults a systematic review and meta-analysis of randomized trials was conducted. In this review incentives increased exercise adherence 80% of the time, by about 12% on average (SD 5.61%, 17.50%; test for overall effect $z=3.81$, $p<0.0001$). Notably, potentially more effective incentive design features (e.g., certain vs. uncertain incentives) were identified, suggesting incentive effectiveness is influenced by program design. In a qualitative study (Chapter 4), it was determined that opinions around incentives were not necessarily negative but were contingent on incentive structures (e.g., voucher-based incentives preferred over cash). Since opinions regarding incentives appear to vary with

design features, a new questionnaire was developed to facilitate the identification of more amenable incentive programs (Chapter 5). The final questionnaire comprised of 23 psychometrically sound items. In Chapter 6, results of an incentives-in-CR feasibility study are presented. In this study several methodological issues were identified that should be addressed before moving onto a confirmatory trial (e.g., low study enrollment). Notably, it is not clear whether self-determined motivation was undermined by the incentive intervention. In summary, this body of work suggests incentives may have a role to play in promoting regular exercise following CR, but further refinement of the intervention and study design are required before conducting a fully powered RCT.

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List of Publications*

Chapters 1 and 2

Mitchell, MS & Faulkner, G. A nudge at all?: The jury is still out on financial health incentives. *Healthcare Papers*. 12(4): 31-36, December 2012.

Chapter 3

Mitchell, MS, Goodman, J, Alter, D, Oh, P, John, L, Pakosh, M, & G. Faulkner. Financial incentives for exercise adherence in adults: A systematic review and meta-analysis of randomized controlled trials. *American Journal of Preventive Medicine*. (45) 5: 658-667, November 2013.

Chapter 4

Mitchell, MS, Goodman, J, Alter, D, Oh, P, & G. Faulkner. ‘Will walk for groceries’: Acceptability of financial health incentives among Canadian cardiac rehabilitation patients. *Psychology and Health*, 29 (9): 1032-43, April 2014.

Chapter 5

Mitchell, M, Goodman, J, Alter, D, Oh, P, & G. Faulkner. Development of the Health Incentive Program Questionnaire (HIP-Q) in a cardiac rehabilitation setting. *Translational Behavioral Medicine*, Published online June 26, 2015.

Chapter 6

Mitchell, M, Goodman, J, Alter, D, Oh, P, Leahey, TM, & GE. Faulkner. A feasibility study of financial incentives to increase exercise among Canadian cardiac rehabilitation patients. *Journal of Cardiopulmonary Rehabilitation and Prevention*, Published online July 22, 2015.

*Chapters represent modified versions of the publications listed.

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Chapter 1

1 Introduction

1.1 Background

Canadians are both less physically active and more obese compared to previous generations (Shields et al. 2010). This trend, combined with an aging demographic, is expected to significantly burden Canada's health care system, particularly in managing the anticipated rise in cardiovascular disease (CVD). According to a 2009 Public Health Agency of Canada report, 1.6 million Canadians have heart disease or are living with the effects of stroke (PHAC 2009). In addition, the number of older Canadians (65yrs+) at higher risk for CVD because of their age will increase to 17.8% by 2021, up from 13.1% in 2005 – a 36% relative increase (HSF 2010). More doctor visits for CVD management, a rising need for prescription medications, and costly CVD-related hospitalizations are expected to drive provincial/territorial health care spending to unmanageable levels (PHAC 2009).

Fortunately, CVDs like coronary artery disease and stroke are preventable. According to the World Health Organization, over 80% of coronary artery disease (the most prevalent of the CVDs) can be avoided with proper nutrition, smoking cessation, and regular physical activity (WHO 2014). While primary prevention is optimal (that is, before the clinical manifestation of CVD), there are many benefits of secondary prevention as well. For instance, cardiac rehabilitation (CR) and secondary prevention programs, comprehensive outpatient programs designed to help individuals recover from and manage their CVD, have been shown to improve CVD risk factors (Lavie and Milani 2011), prevent hospitalizations (Martin et al. 2012) and reduce deaths from any cause by 50% (Alter et al. 2014).

Unfortunately, resource constraints usually limit the duration of formal, supervised CR to 6 months or less in Canada (in the U.S., most patients are eligible for 4.5 months of CR) (Hammill et al. 2010). In light of these constraints and given the well-established benefits

of long-term exercise adherence (i.e. > 6 months), CR programs are increasingly looking to prepare their patients for ‘life after rehab’ and put mechanisms in place that support the transition to independent exercise (‘self-management’). Despite the existence of post-supports (e.g., education series, supervised drop-in sessions, peer support) exercise adherence among CR graduates precipitously low with up to 83% of patients not adhering to their exercise regimen two years later (Zullo et al. 2010; Pinto et al. 2011; Sweet et al. 2011).while over 2,500 patients graduate from the University Health Network’s (UHN) Cardiovascular Prevention and Rehabilitation Program each year, as few as 600 patients (Bentley et al. 2013), and as many as 1,900 patients (Sweet et al. 2011), may be discontinuing their exercise within a few years of program completion.ow post-program compliance puts patients at risk for future cardiovascular events, expensive hospitalization and/or premature death (Berent et al. 2010)rovisions for the long-term continuation of exercise after CRneed to be improved.

1.2 Financial health incentives: Part of the solution?

Theories have been developed that aim to change attitudes about exercise, increase self-efficacy to engage in exercise, and help individuals learn the self-regulatory skills theorized as required to *maintain* exercise for longer periods – monitor activity levels, set goals, plan for activity and so on. In light of increasing rates of physical inactivity in Canada, there is recognition of the need to adopt a broader social-ecological approach to these issues recognizing that behaviour is influenced across multiple domains including the individual, social, physical and policy spheres. One consequence of this is that the solution will require a comprehensive, multi-level approach and one target for intervention is the economic domain.

This line of reasoning was the motivation for a scoping review examining economic instruments for obesity prevention/reduction conducted by Faulkner and colleagues (2010). In this review, Faulkner et al. conceded that very little research had examined the effectiveness of economic instruments (namely taxes and/or subsidies) targeting physical activity (Faulkner et al. 2011). Absent from the review and discussion of economic policy tools to promote physical activity were financial health incentives (referred to as ‘incentives’ herein), operationally defined as ‘monetary rewards contingent on health

behaviour change' (Adams et al. 2013) (p. 2). What distinguishes incentives from other economic policy instruments is the *contingency* aspect of the approach (e.g., lose weight, win cash; quit smoking, earn groceries; exercise regularly, get a free gym membership). A growing body of scientific evidence has shown that incentives may promote health behaviour change. For example, a number of systematic reviews have shown that incentives can motivate 'single shot' (e.g., clinic visits) (Sutherland et al. 2008) and 'lifestyle' health behaviours, such as healthy eating (Purnell et al. 2014), smoking cessation (Cahill and Perera 2011) and weight loss (Burns et al. 2012; Gilles 2014).

Given their demonstrated potential, incentives have emerged in public health policies globally (Ries 2012). In 2004, Germany was the first Western nation to introduce incentives on a population-scale under the German Social Code (Stock et al. 2010). In an analysis of one of Germany's largest 'sickness funds', Stock et al. found that incentives (e.g., cash, in-kind, lower premiums/co-pays) for primary and secondary prevention activities (e.g., cancer screening, gym attendance) reduced direct health care costs by 100 euros per year compared to matched controls. Since 2004, several other countries have enacted incentive-based public health policies as well, including the U.K., Australia and the U.S. (Ries 2012). Notably, in 2010, the Patient Protection and Affordable Care Act legislated that U.S. employers could reimburse their employees even more money for achieving health targets or for engaging in healthy behaviours (i.e. employees can be reimbursed 50% of their health insurance premiums, up from 30%). While some private U.S. firms have been offering incentives for many years (e.g., Johnson & Johnson for 25yrs), their popularity has increased of late with 90% of large U.S. employers offering incentives for wellness program participation, or for meeting pre-specified health outcomes in 2015 (NBGH 2010).

Only recently have incentives emerged as a policy alternative in Canada. Most notably, in 2011 the Public Health Agency of Canada a Provincial governments and large Canadian NGOs are also looking to implement province- and nation-wide incentive programs. A small but growing number of Canadian companies are also incorporating incentives into their package of benefits. Notably, 13% of companies surveyed in the 2013 Sanofi Health Care Survey indicate offering incentives to their employees (Sanofi 2013). Given the

mounting health economic strain of chronic disease in Canada, and increasing interest in incentives as a health promotion tool in general, the time is ripe for research examining the role of incentives-for-health in .

1.3 Gaps in the literature

1.3.1 Incentives-for-exercise

While systematic reviews have examined the effects of incentives on other ‘lifestyle’ health behaviours, such as weight loss and smoking cessation, there has been less study of the impact of incentives on exercise specifically—arguably the behaviour most closely associated with health and longevity (Blair et al. 1989; Ross and Janiszewski 2008). Separating the effect of incentives on exercise from their effect on weight loss is important because incentive effectiveness is believed to be moderated by the behaviour/outcome targeted (Jeffery et al. 1993; Wing et al. 1996; Charness and Gneezy 2009). According to Jeffery et al. (Jeffery et al. 1993; Jeffery et al. 1998), Wing et al. (Wing et al. 1996), and Charness and Gneezy (Charness and Gneezy 2009), for instance, incentives contingent on an immediate, directly observable behaviour (e.g., exercise) may produce different effects than rewards contingent on distal consequences of behaviour (e.g., weight loss). Similarly, in their review of incentives for weight loss, Paul-Ebhohimhen and Avenell observed “a very weak trend...in favor of reward for behaviour change than reward for weight” (Paul-Ebhohimhen and Avenell 2008) (p. 366). Learning more about the effects of incentives on weight-related behaviours, such as exercise, and not just outcomes, may optimize incentive interventions in the future.

1.3.2 Long-term effectiveness

Despite a growing body research, the utility of incentives for *long-term* health behaviour change remains unclear. On the one hand, incentives have consistently increased the occurrence of ‘single shot’ health behaviours (Sutherland et al. 2008) and have improved ‘lifestyle’ health behaviours in the short-term (i.e. < 3 months) (Pope and Harvey-Berino 2013). Incentives have been shown to produce long-term changes in some cases (i.e. > 12 months), so long as the incentive was not withdrawn (Jeffery et al. 1998). On the other hand, incentives have rarely produced ‘lifestyle’ health behaviour changes that persist

into the critical post-incentive period (Burns et al. 2012). One reason for this may have to do with the limited application of health behaviour change theories in the design of incentive programs. It is increasingly suggested that for incentives to both stimulate *and* sustain health behaviour change they should be grounded in theory (Burns et al. 2012; Oliver 2012; Loewenstein et al. 2013). A key limitation in the design of incentive programs to-date has been this apparent lack of theoretical consideration.

1.3.3 Sub-optimal incentive 'design'

As outlined by Klein & Karlawish (2010) and more recently by Adams et al. (2013), incentives can be designed along nine core features that possess a range of attributes, including type, timing, and magnitude of incentive, as well as probability of distribution, participant investment, information disclosure, and dispensing type. To date, not enough attention has been paid to these design features even though they have influenced incentive effectiveness in the past (John et al. 2011; Volpp et al. 2011; Kullgren et al. 2013). Systematic reviews by Kane et al. (2004) and Paul-Ebhohimhen & Avenell (2007) provide a case-in-point. They observed that the timing and magnitude of incentives as well as the method of incentive delivery were not justified in any of the studies they reviewed. This suggests that explicit decisions regarding critical incentive design features have not been made or articulated.

Furthermore, in the design of incentive programs there appears to be little consideration of the contextual factors, such as an individual's age, past health behaviours, disposable income, psychological profile and incentive preferences, believed to influence incentive effectiveness. Indeed, for some individuals, and in some situations, incentives may not be warranted at all (e.g., exercise-based incentives for long-time exercisers). It is also not clear if incentive preferences vary among individuals or between groups with shared characteristics (e.g., overweight individuals, older adults), or how incentives influence the cognitive or motivational processes believed to mediate incentive effectiveness (e.g., self-determined motivation, self-efficacy). Indeed, poor incentive designs that neglect individual and group differences (e.g., incentive preferences, income), as well as the cognitive factors facilitating incentive effectiveness (e.g., self-efficacy), are limiting effectiveness and broader implementation. Learning more about preferred incentive

structures, and how these vary for individuals and groups, is an area worthy of further inquiry.

1.3.4 Paying the patient: Is it acceptable? Does it work?

While the cost-effectiveness of incentive interventions may be greatest when targeting preventive health behaviours in clinical populations (Loewenstein et al. 2013), little research has been done in the area, especially within the context of the universal Canadian health care system. To my knowledge, patient-targeted incentives have been scarcely evaluated in the context of Canadian health care, where their acceptability and effectiveness may be different than in the U.S. – the origin of the majority of the incentive research. Indeed, previous research has shown incentive acceptability (Promberger et al. 2011) and effectiveness (John et al. 2012) to be inextricably linked with contextual factors such as health status and country of origin. Cardiac rehabilitation is a suitable initial target for incentives in Canadian health care since many of the CVD risk factors are modifiable and under behavioural control. In particular, since up to 83% of CR program graduates discontinue regular exercise (Sweet et al. 2011), the role of incentives in promoting prolonged, post-CR exercise should be explored. While Ades & Galema (2012) were one of the first to suggest incentives may have a role to play in CR (Ades and Gaalema 2012), the approach in CR

1.4 Purpose

This work is targeted directly at improving long-term exercise adherence in a CR population through a better understanding of how to design more acceptable and effective incentive programs. Until recently, incentives have been designed with limited theoretical and contextual consideration. Realizing the potential of incentives to promote sustained exercise adherence among Canadian CR patients, therefore, will be contingent on research that improves the understanding of theoretical (e.g., self-determined motivation) and contextual (e.g., incentive preferences) factors that may influence incentive program effectiveness. The results of this research may inform larger studies aiming to optimize incentive programs, and ultimately, to determine whether incentives are worthy of broader implementation. While the primary objective of this thesis is to improve the long-

term continuation of exercise in a CR population, results may be generalizable outside the CR context as well, in other clinical and workplace settings, where patient and employee adherence to health behaviours could be improved.

Chapter 2

2 Literature review

2.1 Cardiac rehabilitation: Saving lives, money

Cardiac rehabilitation (CR) programs are short-term (usually 6 months or less), yet comprehensive and multi-disciplinary, outpatient programs designed to help individuals recover from and manage their cardiovascular disease (CVD). Within the context of contemporary cardiovascular service provision, the health benefits of CR are well established. For example, several systematic reviews demonstrate that CR participation is associated with reductions in total (approx. 30%) and cardiac (approx. 20%) mortality (Ades 2001; Jolliffe et al. 2001; Piepoli et al. 2004; Taylor et al. 2004). According to one retrospective study, the magnitude of the survival benefit associated with CR in Ontario is closer to 50% (Alter et al. 2009), with attendance moderating the mortality benefit (i.e. better attendance leading to greater survival). In addition, CR has also shown to be a cost-effective health care intervention (Oldridge et al. 1993; Yu et al. 2004; Papadakis et al. 2008), though cost-effectiveness appears to vary with CVD risk, reason for referral, demographics and program duration.

2.2 Participation rates

Despite the health and economic benefits of CR, programs have consistently struggled to optimize participation rates. Low referrals and sub-optimal attendance, for instance, have been limiting program impact for years. An excerpt from Carlson et al. (2000) helps to illustrate this point:

“Unfortunately, <25% of eligible candidates for cardiac rehabilitation actually participate in formal programs. Of those who participate, 25% to 50% “dropout” within 6 months and up to 90% by 1 year. Moreover, 25% of the dropouts continue an exercise program sufficient to maintain or improve cardiorespiratory fitness.” (p. 17)

In Canada, CR referrals remain precipitously low (i.e. around 25% of eligible inpatients) and strategies to increase them have been recommended (Grace et al. 2011). Similarly, for those who are referred to CR, many do not participate optimally and do not reap the health benefits of full participation. According to a recent study, Alter et al. (2014) found that the risk of death or hospitalization among CR program graduates decreased with progressive increases in CR program attendance. This dose-response relationship reinforces the importance of fuller CR participation.

Low post-CR exercise adherence remains a major issue as well given the central role of exercise maintenance in addressing the “pathological atherosclerotic milieu” characterizing CR patients (Grace et al. 2011) (p. E2). A short course of CR is inadequate if it is not accompanied by long-term exercise adherence. In other words, physically inactive CR graduates are at greater risk of worsening CVD risk factors, recurrent morbidity and premature death (Berent et al. 2010; Chase 2011). Several studies have examined exercise adherence in the months and years following CR. While the results vary with program length and intensities, patient characteristics and measurement methods, generally speaking, between 25% and 75% of CR program graduates discontinue their regular exercise routines (Chase 2011). At UHN, one of the largest publicly funded CR program in Canada, this equates to between 600 and 1900 patients (out of 2,500) per year. Poor post-program adherence, therefore, is a critical issue.

The studies examining post-CR exercise are often limited by self-reported measures, low response rates and self-selection bias. In the one study conducted at UHN examining post-program exercise adherence, Bentley et al. (2013) found that 75% of survey respondents were meeting Canada’s Physical Activity Guidelines (i.e. 150 min of at least moderate intensity activity). The response rate in this study was only 35%, however, making it difficult to draw strong conclusions regarding post-program behaviours in this . It is plausible that a majority of the 65% of those who did not respond to the survey did not do so because they had discontinued their exercise. While I can only speculate about non-respondents in the Bentley et al. (2013) study, evidence from other post-CR studies help round out the post-CR picture.

Bock et al (2003), for instance, found that 35% of CR graduates from a large urban Phase II/III CR program (n=100; inpatient and outpatient) reported doing ‘less physical activity’ than at program completion 12 months later (Bock et al. 2003). Notably, patients participating in Phase III (outpatient) rehab were more likely to be exercising after the final program contact than patients completing inpatient CR only. Similarly, in a sample of sixty-four female CR graduates, 35% of study participants were not exercising three months after CR completion with comorbid conditions and lack of social support predicting low post-program compliance (Moore et al. 2003). Among 463 CR program graduates in Kent Ohio, 59% self-reported that were not meeting physical activity guidelines one-to-two years later (Zullo et al. 2010). Recognizing sub-optimal post-CR compliance in general, several studies have recently developed and tested interventions with the aim of supporting the transition to independent exercise. These studies help to illustrate the post-CR participation issue as well. In a 2009 Australian RCT for example, the number of weekly exercise sessions dropped by 2.4 sessions *per week* amongst forty-six control-group participants (Butler et al. 2009). In another randomized trial, Pinto et al. (2011) found that minutes of exercise per week progressively decreased following CR program completion in the control (n=66), but not the intervention (n=66), arm of the study.

Next to the Bentley et al. (2013) study noted above, the research conducted by Sweet et al. (2011) is probably most relevant in the context of Canadian CR (participants were recruited from Ottawa and Kingston, Ontario, Canada). The sample was larger than previous studies (n=251) and the retention rate was very high as well, with data available for 87% of participants at 24-months. Discouragingly, but consistent with the hypothesis that CR graduates discontinue regular exercise, Sweet et al. (2011) found that only 17% of participants maintained their exercise levels over two years. Notably, individuals with high barrier self-efficacy and self-determined motivation were more likely to exhibit a ‘maintainer’ pattern of exercise.

In contrast, Blum et al. (2014) found that following 12 weeks of CR, aerobic fitness persisted for 17 months, or about 1.4 years (Blum et al. 2013). It is difficult to pinpoint the reasons for these favourable results, though the authors contend that the intense nature

of the program (i.e. 3 weekly sessions in a relatively short-period, 12 weeks) may have translated into superior post-program behaviours. As well, the Blum et al. (2014) study was conducted in Switzerland, and corroborating studies (that is, studies with similar results) were conducted in Norway, Germany and Hong Kong, which limit the generalizability of the data to a Canadian context (Madssen et al. 2014; Yu et al. 2004).

2.3 Participation barriers

The barriers to full CR participation are many and varied and the research exploring them is extensive (de Melo Ghisi et al. 2013; Shanmugasegaram et al. 2013; Shanmugasegaram et al. 2013; O'Connell 2014). Two papers in particular have examined barriers to regular exercise among CR graduates specifically (Petter et al. 2009; Bentley et al. 2013). Petter et al. (2009) and Bentley et al. (2013) not only explored exercise maintenance barriers in post-CR populations but they also framed their analyses using the social-ecological framework, an increasingly valuable theoretical tool. In order to draw a complete picture of exercise behaviour, we must acknowledge as many exercise correlates as possible (e.g., patient/provider to policy level correlates). The social-ecological theory of behaviour change offers a platform from which to consider correlates at multiple levels, including the intra- and inter-personal, institutional, community and policy levels, which have unique and interacting effects on exercise (see Figure 2.1). The review by Petter et al. (2009), for example, highlights the most important correlates driving exercise maintenance in CR graduates into five categories within the social-ecological framework. This review has been a valuable addition to the literature, which has largely under-appreciated the roles of factors outside the level of the individual.

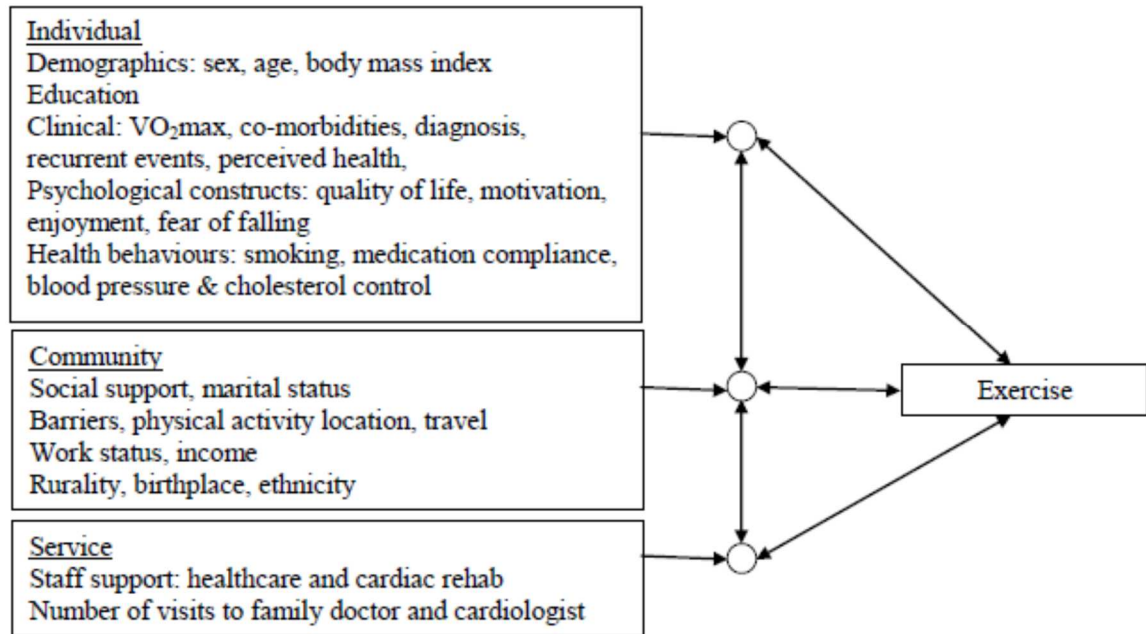


Figure 2.1. Applying the social-ecological theory to exercise behaviour in a cardiac population.

The narrative review by Petter et al. (2009) examined over one hundred studies (including a total of more than 25,000 participants) and uncovered several factors consistently predicting post-CR exercise, including: intra-personal (self-regulatory self-efficacy, health status, control), inter-personal (social support), institutional (morning vs. afternoon classes, education vs. no education), and community (distance to travel and program location) level factors. In addition, Petter et al. (2009) identified several perceived barriers to exercise maintenance amongst CR graduates, including: personal (scheduling, motivation), social (family support) and environmental (cost, access) barriers. The authors also argued that: “interventions would need to be tailored according to the type of barrier that poses a problem for a particular patient.” (p. 520) For example, personal, social and environmental barriers could be addressed with an incentive program aiming to (1) boost motivation to self-monitor exercise, (2) reward group/family goals, and (3) offset exercise-related costs (e.g., gym memberships, parking). At the intra-personal level, Petter et al. (2009) also suggested that individualized post-CR feedback

may be one way of supporting self-regulatory self-efficacy and drive sustained behaviour change in this population (e.g., periodic stress testing, exercise diary feedback). Action planning was also viewed as particularly valuable for exercise maintenance, especially if targeting perceived barriers. No policy level factors influencing exercise maintenance were reviewed in this study though the authors suggest policies legislating community kinesiologist support, for example, or gym membership re-imburements, may facilitate exercise maintenance amongst CR graduates.

Bentley et al. (2013) presented a list of exercise maintenance correlates in a sample of 584 UHN CR program graduates (Mean age=69.8 years, 80% male, 75% post-secondary education). At the intra-personal level, they found, amongst other things, that co-morbid conditions and fear of falling predicted non-adherence. Bentley et al. (2013) were also the first to suggest that physical activity enjoyment, having a personal form of transportation to exercise facilities (i.e. own/drive their own car), and CR staff support, predict post-program compliance. Several approaches have been recommended to address some of these correlates/barriers to continued participation and bridge the gap to independent exercise for CR graduates. A selection of studies designed to support community-based exercise for CR graduates is presented next.

2.4 Post-program interventions

Several behavioural strategies have been employed to improve exercise adherence in cardiac populations (Biddle and Mutrie 2008). The list of strategies include: goal setting, feedback, action planning, self-monitoring (daily activities, body weight or heart rate), problem solving or coping, written and oral commitment, stress management, persuasive written and telephone communication, small group interaction and peer modeling, intervention targeting spouses as well as participants, and physician/health provider engagement. Regarding CR graduates in particular, a systematic review of the literature was conducted in 2011 to identify promising post-program interventions (Chase 2011). While significant heterogeneity existed between interventions and populations (CR programs around the world vary greatly in duration, intensity, focus etc.), Chase et al.

(2011) confirmed that while physical activity levels achieved during CR decrease after program completion, behavioural (rather than cognitive) interventions such as (1) self-monitoring with an activity log or pedometer, (2) prompting (e.g., during clinic visits, phone calls) and (3) objective feedback may facilitate continued exercise. The findings from this review highlight what others have concluded in other related fields – *that when it comes to ‘lifestyle’ health behaviour change, reminder systems, not education, are more likely to promote regular exercise* (Quigley 2015).

A 2009 RCT conducted in Australia helps to illustrate this point. Butler et al. (2009) found that a six-month pedometer-based intervention increased exercise participation in the intervention, but not the control, arm of the study. In this study, CR graduates were given a low-cost pedometer and instructed to record steps per day (i.e. objective feedback) and set weekly/monthly step/minute goals. They also received four telephone calls over six months from a trained motivational interviewer who provided behavioural counseling (e.g., verbal reinforcement, individualized goal setting, problem solving) (Butler et al. 2009). In a similar study, Pinto et al. (2011) found that exercise self-monitoring, pedometry and regular activity counseling led to significant increases in weekly exercise compared to controls (i.e. 80 minutes) (Pinto et al. 2011). Notably, social support from friends mediated the increase in exercise maintenance. Interestingly, program attrition was high in this study, around 30% (vs. 15% in other similar but less intense trials), suggesting a simpler, streamlined approach to supporting graduates is required.

Ades & Galeema (2012) were one of the first to suggest incentives may have a role to play in increasing CR participation, though a study conducted by Leslie et al (1991) may have been the very first attempt to deploy incentives in CR. In offering ‘token’ incentives (e.g., t-shirts, access to home exercise equipment), the authors were able to increase CR knowledge, which was assessed by the 16-item Exercise Knowledge Test (Leslie and Schuster 1991). Ades & Galeema (2012) and others now claim that CR is a suitable target for incentive intervention since many CVD risk factors are under behavioral control. To my knowledge, researchers at the Mayo Clinic were the next to evaluate incentives in CR in 2013 by again examining the impact of ‘token’ incentives (e.g., t-shirts, parking

passes) on program attendance (Pack et al. 2013). Though the Pack et al. (2013) study boasts several strengths, the authors did not randomize study participants, nor were they able to isolate the impact of incentives from other intervention components. For this reason, a definitive randomized trial testing the efficacy of incentives in CR is still warranted.

Rather than target program attendance, I sought to use incentives (a potentially effective *and* scalable intervention) to support the difficult transition to unsupervised, community-based exercise. The greatest risk of incentive intervention may be its potential to undermine intrinsic, or self-determined, motivation – the psychological factor most closely associated with *long-term* exercise in a CR population (Slovinec D'Angelo et al. 2014). If the overarching objective of this body of work is to drive *sustained* behaviour change, and incentives have been theorized to damage the potential for quality, long-term exercise (Moller et al. 2012), a careful exploration of the theoretical foundation for this novel, albeit controversial, approach is warranted.

2.5 Theoretical overview

Exercise is a complex behaviour that involves many steps and a series of skills to adopt *and* maintain. Since it is impossible to consider all possible influences on exercise (see the complex relationship between exercise and the factors that influence it in Figure 2.), psychological theories and models of behaviour change can be used to help explain when and why individuals choose to engage, or not, in exercise. Exercise can be assessed using five classes of behaviour change theories. These include theories that emphasize (1) beliefs and attitudes (e.g., theory of planned behaviour) (2) perceptions of control (e.g., self-determination theory) (3) perceptions of competence (e.g., self-efficacy theory) (4) stages of change (e.g., trans-theoretical model) and (5) hybrid approaches (e.g., health action process approach, protection motivation theory). Each theory or class of theory emphasizes different constructs (e.g., key exercise predictors vary with the theory deployed therefore using multiple, complimentary theories/hybrids may increase predictive abilities). Considering these theories allows us to draw a picture of behaviour change that takes a very broad range of factors into account. Only once this picture is drawn will we be able to identify critical areas for action and the role of interventions in

promoting exercise. In particular, targeting correlates that explain the most variance in exercise behaviour in a specific population/scenario will increase the likelihood that an intervention will work. According to several high-quality studies, it appears that (1) self-determined motivation and (2) exercise self-efficacy do the best job of predicting exercise *maintenance* in a CR population (a full description of these key constructs is below) (Woodgate et al. 2005; Sweet et al. 2011; Slovinec D'Angelo et al. 2014).

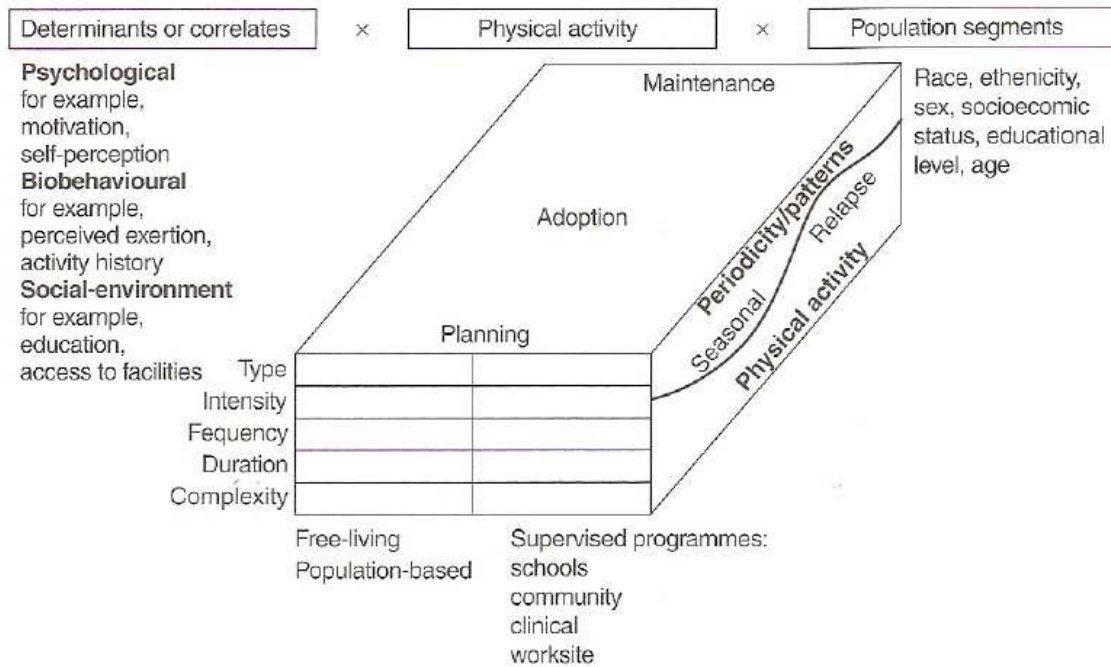


Figure 2.2 Dishman's (1990) lifespan interaction model.

Many theories could be deployed in the analysis, design, implementation or evaluation of exercise interventions. Combined, these theories identify hundreds of exercise correlates: demographic, physiological, psychological, behavioural, socio-cultural, and environmental. In the context of CR, and in considering the role that incentives may play in promoting exercise adherence, two theories of behaviour change seem particularly relevant. First, self-determination theory has extended cognitive evaluation theory's emphasis on the role of reward structures in behaviour change to include three innate psychological needs (which increases the predictive capabilities of the theory) and in doing so provides valuable insight into how incentives may be used to build, rather than

harm, intrinsic motivation. Second, self-efficacy theory emphasizes the important role of self-efficacy in driving/inhibiting exercise behaviours, especially long-term adherence. Both of these theories address issues that help to explain the utility of incentives in a CR context. The theoretical overview below will begin, however, with an introduction to a relatively new field of economics, called behavioral economics, since it has stimulated renewed interest in incentive-based health interventions globally.

2.5.1 Behavioural economics

In 2008, Richard Thaler and Cass Sunstein popularized behavioural economics, a relatively new branch of economics complimented by insights from psychology, in a book entitled, *Nudge: Improving decisions about health, wealth, and happiness*. Most of the ideas in behavioural economics are not new, according to Camerer & Loewenstein (2003), as it really just “...returns to the roots of neoclassical economics after a century-long detour” (p. 5). Behavioural economics, often referred to as nudge theory, may be best thought of as a “set systematic, frequently reported observations that conflict with the assumptions underlying standard economic theory” (p. 9) – namely, that humans are rational decision makers (Oliver 2012). Nudge theory acknowledges that human judgments are biased in systematic ways and that these biases can make it difficult for people to make rational, self-beneficial choices (Camerer and Loewenstein 2003). For example “present bias” refers to the tendency to act in favour of one’s immediate self-interest at the expense of one’s long-term well-being; in other words, immediate costs and benefits exert disproportionate influence on people’s choices relative to those that will be experienced some time in the future. In the case of exercise, the “costs” are experienced in the present (e.g., time, uncomfortable feelings); whereas the benefits (e.g., health, longevity) are delayed, resulting in notorious resolutions to “exercise more tomorrow”. According to nudge theory, increasing the immediately rewarding aspects of exercise (e.g., by offering incentives, a type of nudge, such as grocery vouchers for regular exercise) may tip the so-called ‘decisional balance’ and increase people’s propensity to exercise. Other nudge theory decision biases include (1) “loss aversion” (i.e. losses loom larger than equivalent gains), “probability weighing” (i.e. people think they have a better chance of winning lotteries than they actually do), and “default bias”

(i.e. people tend to favour the ‘default’ choice, or *status quo*). The “default bias” can be an extremely valuable target for intervention since people habitually, and predictably, go along with pre-determined choices.

The reasons for CR program effectiveness and cost-effectiveness are many and varied and include an appropriate emphasis on regular exercise, a multi-disciplinary approach to CVD risk reduction, and evolving delivery models to satisfy changing landscapes (e.g., home-based CR for working adults). Another less obvious reason for CR program effectiveness may have to do with the ‘design’ of the CR program environment – specifically the impact of subtle, maybe inadvertent, design decisions on program effectiveness. Environmental design, it turns out, can have a significant impact on human decision-making. Design can refer to almost anything, including the physical positioning of people or items (e.g., stairs or hand sanitizing stations), the way key messages are framed (i.e. positively or negatively; or that appeal to social norms), or the effort required on the part of an individual to accomplish health-related tasks. In *Nudge* (2008), Thaler & Sunstein coined the term “choice architecture” to describe the process whereby environments can be designed to facilitate healthy choices.

Thaler & Sunstein wrote that a nudge is “...any aspect of the choice architecture that alters peoples’ behaviours in a predictable way...” (Thaler and Sunstein 2008) The classic example in the health domain has to do with the design of cafeterias – that is, the strategic placement and presentation of healthy foods in cafeterias to promote healthy food choices. Setting up a separate salad bar line at the cafeteria entrance increased healthy food sales by 18% in a recent example (Hanks et al. 2012). The *Nudge* (2008) authors argued that if cafeterias could be deliberately designed to promote healthy food choices then shouldn’t we at least try to create environments that facilitate other self-beneficial choices? Evidence from nudge-inspired policies in government and corporate settings globally suggest that the answer to this question is a resounding ‘yes’ and Dolan et al. (2010) provide a useful summary of nudge-inspired public policies (Dolan et al. 2010).

In summary, by acknowledging psychological tendencies that underlie decision-making and the malleability of human choices, nudge theory offers a descriptively accurate portrait of human behaviour and is thus a strong theoretic foundation from which to generate practical techniques for promoting behaviour change. According to Thaler & Sunstein, the proper application of nudge theory may actually make health behaviours such as exercise *easier* – for example, by offsetting the “present bias” with pre-commitments or modest incentives, by providing individualized feedback that appeals to social norms, and by setting defaults to promote self-beneficial behaviours. Recognizing the predictable decision errors that characterize human beings, and trying to correct them through thoughtful choice architecture, may help people help themselves. While nudge theory is not a cure-all, it is proving to be an effective way of promoting socially beneficial behaviours (Dolan et al. 2010).

2.5.2 Self-determination theory

While behavioural economics describes how incentives may tip the “decisional balance” and exploit “decision biases” to promote short-term behaviour change (Camerer and Loewenstein 2003), self-determination theory, a global theory of motivation, focuses on the extent to which behaviours such as exercise are done volitionally or are controlled by external agents (e.g., a CR supervisor) or some form of contingency, such as incentives (Deci and Ryan 1985; Deci and Ryan 2002). In other words, behavioural economics provides insight into why and how incentives might be a catalyst for behaviour change, and self-determination theory explores the conditions under which time-limited incentives may or may not sustain behaviour change once the incentive is removed. It can take several months if not years before any exercise becomes intrinsically reinforced (the less fit an individual the longer it may take), and so considering self-determination theory in the design of incentive programs for *long-term* health behaviour change is important.

As a global theory, self-determination theory is made up of four mini-theories (see Deci and Ryan [2002] for a comprehensive overview). Two of these are particularly worth mentioning. First, cognitive evaluation theory concerns the conditions that facilitate or hinder the development of intrinsic motivation. Cognitive evaluation theory considers that rewards may serve two primary functions. On the one hand, they may provide an

informational role in providing feedback on an individual's competence to perform a behaviour. On the other hand, they may perform a controlling function if the goal of performing the behaviour becomes attaining the reward rather than participating for intrinsic reasons. Of interest is the “over-justification” or “crowding-out” effect – that rewarding individuals for participating in intrinsically interesting tasks may reduce intrinsic motivation once the reward is no longer offered. One practical inference from self-determination theory is that incentives need to be shaped in a way that they enhance feelings of competence.

Intrinsic motivation is defined in self-determination theory as the desire to do something for its own sake and in the absence of external pressures (Deci and Ryan 2002). At a population level, we would hope that people find physical activity to be truly intrinsically motivating. This is rarely the case, however. Organismic integration theory describes the extent to which behaviour is motivated for different extrinsic reasons that represent varying degrees of internalization. In this mini-theory, Deci and Ryan describe a continuum ranging from amotivation to intrinsic regulation. Importantly, between these are four different forms of extrinsic motivation ranging from external regulation (e.g., I am exercising for a financial incentive) to integrated regulation (e.g., I am exercising because it is an important part of who I am). The key difference among these four extrinsic motives is the degree in which they differ in terms of self-determination. More self-determined motives are associated with better behavioural outcomes such as more frequent exercise, greater effort expended to exercise regularly and stronger intentions to continue exercising in the future (Wilson et al. 2004). Movement along the continuum is in part shaped by the degree to which individuals fulfill basic psychological needs of competence (experiencing mastery), autonomy (a sense of ownership over behaviour) and social relatedness (feeling socially connected to others) (Deci and Ryan 1985).

The challenge then becomes this: can the core design features of incentives (Klein and Karlawish 2010; Adams et al. 2013) be manipulated in such a way that they promote the fulfillment of these basic psychological needs? Examples include rewarding the achievement of realistic self-regulatory goals underpinning behaviour, such as the regular wearing of a pedometer or regular exercise self-monitoring to encourage walking;

providing a selection of incentive options to individuals; and providing rewards that are related to social outcomes (e.g., charitable donation) or that promote social interaction (e.g., incentives for group success). If incentive design cannot be manipulated in such a way, then, they most probably will depress intrinsic motivation – moving people toward the extrinsic end of the motivation continuum and threatening long-term adherence (Deci and Ryan 2002). Self-determination theory provides a valuable theoretical framework for this work in carefully considering how incentives might be structured for long-term behaviour change.

2.5.3 Self-efficacy theory

Individuals desire to seek situations where they can display efficacy or competence. Indeed, confidence has been identified at the anecdotal and empirical levels as an important construct in exercise motivation (Biddle and Mutrie 2008) – and as alluded to previously, a lack of motivation is frequently identified as one explanation for exercise adherence and maintenance problems. One set of beliefs known to be related to adherence is self-efficacy beliefs – an individual’s judgement of their capacities to perform specific actions (Biddle and Mutrie 2008). A shift from “reliance on personality traits as predictors of behaviour to a more social-cognitive approach” (Biddle and Mutrie 2008) (p.107) has led to the development of several theoretical perspectives on self-confidence including Bandura’s self-efficacy theory.

Bandura defines self-efficacy as “people’s judgements of their capabilities *to organize and execute courses of action* required to attain designated types of performance. It is concerned not with the skills one has but with judgments of what one can do with whatever skills are possessed.” (Biddle and Mutrie 2008) (p.108). Also according to self-efficacy theory, individuals’ perceptions of their capabilities in particular ‘domains’ are believed to influence their choice of activity, effort expenditure, and persistence in the face of barriers. That is self-efficacy, broadly defined, will not influence behaviour as much as specific types of self-efficacy (e.g., task, barrier). Importantly, it appears that self-efficacy influences, and is influenced by, exercise. Bandura states that as well as being a correlates of exercise, self-efficacy is also influenced by the exercise experience (acutely and chronically) such that mastery exposures are posited to enhance self-efficacy

(Biddle and Mutrie 2008). Interestingly, White (1959) was the first to suggest that rewards may enhance intrinsic motivation through its effects on self-efficacy.

Self-efficacy theory has been tested in a variety of exercise and health contexts. Schwarzer & Renner (2000) tested self-efficacy theory in health-related behaviour contexts and found that “self-efficacy has proven to be a very powerful behavioural determinant in many studies, and its inclusion in theories of health behaviour is therefore warranted.” (p. 490) Marquez et al.’s work with non-patient groups determined that among 45-64 year olds, exercise self-efficacy can increase with intervention, will predict participation (especially in the adoption phase) and will decrease after a period of inactivity (Marquez et al. 2002). Indeed, self-efficacy research suggests that more specific perceptions of competence/self-efficacy are likely to be better predictors of specific behaviours than generalized beliefs in competence. For example, Woodgate et al. (2005) determined that while self-regulatory self-efficacy (scheduling) and task (walking) self-efficacy predicted CR adherence, self-regulatory self-efficacy was the stronger of the two. A large Canadian study (n=801) has since corroborated these findings, concluding that self-regulatory self-efficacy predicted exercise adherence in the six month after a CVD event. Notably, self-efficacy will be strongest for activities similar to the activity experiences and can be increased in dissimilar activities through counselling. An important question in self-efficacy research is what ‘type’ of self-efficacy should be measured (e.g., task, self-regulatory, barrier, coping) and how should it be measured. This is too rarely addressed. Among other things, in order to increase the quality of the self-efficacy based research the measure of self-efficacy must correspond closely with the behaviour in question (e.g., walking five times per week at moderate intensity) and the behaviour must be associated with effort, potential barriers and behavioural self-regulation.

In conclusion, self-efficacy consistently predicts exercise, especially when exercise includes vigorous components, because exercise (unlike teeth brushing, for example) requires planning, effort, and often, considerable barriers. Self-efficacy theory predicts that those high in exercise self-efficacy will be more likely to participate in regular exercise. It has more to do than *just* feeling confident; exercise maintenance has a lot to

do with other motives like appearance, health, social relatedness, psychological well-being, etc. However, it is widely accepted that people have a need to maintain or enhance their self-esteem and thus seek out situations where this is possible. Finally, drawing again from the Sweet et al. (2011) analysis of self-efficacy and motivation patterns in a large cohort of CR graduates, it appears that supplementing CR with strategies to increase self-efficacy (as well as self-determined motivation) may increase long-term adherence. According to Sweet et al. (2011) a significant amount of variance in exercise in a CR graduate population is accounted for by the major dimensions of self-efficacy and self-determination theories.

2.6 Conceptual framework

Drawing from self-determination theory, to drive long-term behaviour change incentives must be designed and delivered in a way that does not undermine intrinsic motivation and threaten long-term adherence. This conceptual framework (Figure 2.3) is based on key constructs outlined in self-determination and self-efficacy theories, as well as behavioural economics, and considers (1) incentive design features, (2) setting and target group characteristics, (3) behavioural target, (4) impact on mediating variables in the behaviour change process (e.g., ‘decisional balance’, ‘self-efficacy’), and (5) the effect on exercise behaviour. This framework informed the development and evaluation of an incentive research program at UHN (see the discussion below).

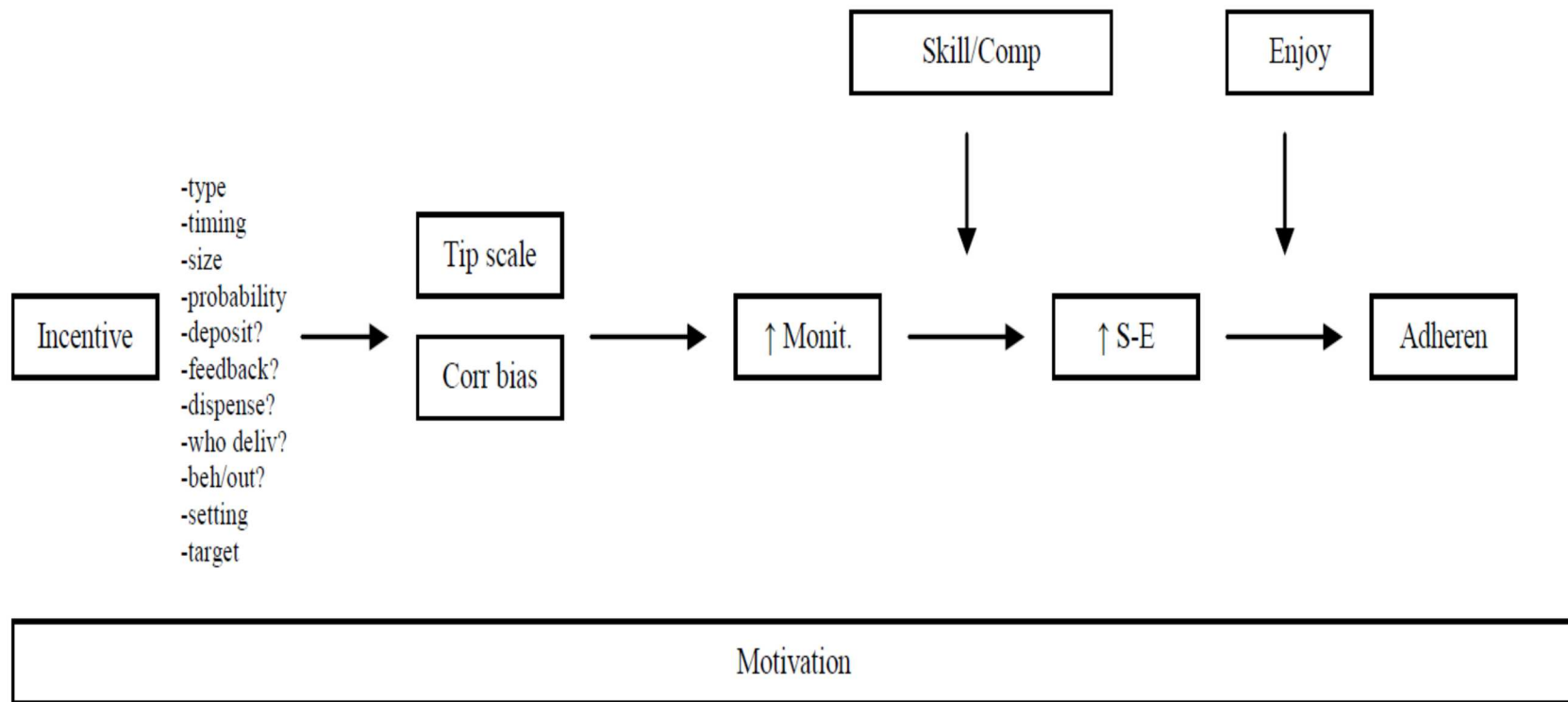


Figure 2.3. Conceptual framework for financial health incentives used to promote long-term, post-incentive exercise adherence.

*Abbreviations: Tip scale=tip ‘decisional balance’; Corr bias=correct ‘decision bias’; Monit.=self-monitoring; Comp=competence; S-E=self-efficacy; Enjoy.=enjoyment; Adheren.=exercise adherence.

The action of self-monitoring is identified in Figure 2.3 as a target for action - rather than exercise *per se*, or an exercise-related outcome like aerobic fitness - since incentives for *self-regulatory* behaviours (e.g., self-monitoring, goal setting) are less likely to “crowd out” intrinsic motivation (Sweet et al. 2011; Mitchell and Faulkner 2012), an often-cited risk of incentive intervention (Moller et al. 2012; Promberger and Marteau 2013). Also, according to a recent meta-regression, self-monitoring is *the* critical component in interventions aiming to increase exercise (Michie et al. 2009). There are several other self-regulatory skills that have been theoretically tested and empirically proven to promote exercise maintenance in a post-CR environment as well, including action planning and goal setting. These could be incorporated into the proposed conceptual framework as well. CR patients at the UHN are asked to fill out and submit exercise diaries on a weekly basis during their program. Offering incentives contingent on continued diary submission would not be new, or perceived as onerous, since patients already chart their exercise.

As illustrated, incentives may increase the motivation to be active in the short-term, if properly designed, by tipping the ‘decisional balance/scale’ and by correcting common ‘decision biases’ (e.g., present bias). Furthermore, incentives that target *realistic* self-regulatory goals underpinning exercise behaviour may help individuals develop a sense of competence (one of three basic human psychological needs described in self-determination theory). Over time this sense of competence, or ‘self-efficacy’, can move individuals toward the intrinsic end of the motivation continuum (depicted along the bottom of the conceptual framework with pure extrinsic motivation on the left and pure intrinsic motivation on the right), where individuals choose to engage in exercise for its own sake, for fun or enjoyment. Indeed, exercise self-efficacy and physical activity enjoyment are the two most potent psychological correlates of exercise maintenance among CR graduates (Woodgate and Brawley 2008; Bentley et al. 2013).

CR graduates are at risk for non-compliance when moving from supervised, group-based CR to the non-supervised, self-management phase of their rehab. This can be explained, at least in part, by the abrupt removal of supervision and group support (external

motivators/pressures) at CR completion. In fact, this lack of supervision and support in the post-CR period has been shown to increase CVD risk (Berent et al. 2010; Sweet et al. 2011). In motivation terms, this subset of externally motivated patients is likely to relapse after CR graduation, when the external pressures are withdrawn. The goal of incentives, then, should be to internalize externally motivated exercise and in doing so facilitate the transition to self-management. In the absence of this key consideration, incentives will not likely produce sustained, post-incentive behaviour change.

Feelings of autonomy ('self-determination') and social relatedness, the other two psychological needs outlined in self-determination theory, may also promote intrinsic motivation among CR graduates. Manipulating incentive design features (listed on the left hand side of the conceptual framework) to satisfy these needs, by providing a selection of incentive options to CR graduates, for example, or by offering rewards that promote social interaction (e.g., option to donate incentives), may also drive sustained behaviour change. Many questions regarding optimal incentive program design remain, however – namely, what design features work for whom and for which behaviours/outcomes? – and may be a focus of future research for many years to come.

This conceptual framework offers researchers and others looking to implement effective incentives a process to consider when designing and evaluating an incentive program. As well, this framework can guide data reporting, so that important details regarding incentive program design features and their impacts on critical mediating steps/behaviours in different populations/settings are not ignored. Until further research systematically examines variations in incentive design features on an informed theoretical basis, I suggest that their potential to drive sustained behaviour change should not be dismissed prematurely. If theoretically driven, incentives may serve as a valuable adjunct to the menu of strategies needed to curb the rising cost of CVD in Canada. Incentives are not the solution, but they might have a role to play as part of the solution.

2.7 Research objectives

Before conducting a fully powered randomized trial testing incentives in CR, and in line with the Medical Research Council's stages of intervention development (MRC 2000), I identified the following inter-related research objectives. The first objective was to describe the rationale for incentives in CR and present a conceptual framework for implementing incentives into clinical practice (Chapter 2). Evaluating the impact of incentives on exercise adherence in adults with a systematic review of the literature was the second objective (Chapter 3). Given the contentious nature of incentive interventions, determining the acceptability of the approach amongst a sample of UHN CR patients was the next objective (Chapter 4). A new questionnaire was also developed to facilitate the design of more acceptable incentive programs (Chapter 5). Finally, to set the stage for a definitive randomized controlled trial, a theoretically driven feasibility study was conducted in a sample of CR graduates (Chapter 6). The primary objectives of this feasibility study were to examine whole-trial feasibility, report a range of feasibility outcomes and demonstrate intervention promise

Chapter 3

3 Financial incentives for exercise adherence in adults: Systematic review and meta-analysis

3.1 Abstract

Context: Less than 5% of U.S. adults accumulate the required dose of exercise to maintain health. Behavioural economics has stimulated renewed interest in economic-based, population-level health interventions to address this issue. Despite widespread implementation of financial incentive-based public health and workplace wellness policies, the effects of financial incentives on exercise initiation and maintenance in adults remain unclear.

Evidence acquisition: A systematic search of 15 electronic databases for RCTs reporting the impact of financial incentives on exercise-related behaviours and outcomes was conducted in June 2012. A meta-analysis of exercise session attendance among included studies was conducted in April 2013. A qualitative analysis was conducted in February 2013 and structured along eight features of financial incentive design.

Evidence synthesis: Eleven studies were included (N=1,453; 18 to 85yrs and 50% female). Pooled results favored the incentive condition ($Z = 3.81$, $P < 0.0001$). Incentives also exhibited significant, positive effects on exercise in eight of the 11 included studies. One study determined that incentives can sustain exercise for longer periods (>1 year), and two studies found exercise adherence persisted after the incentive was withdrawn. Promising incentive design feature attributes were noted. Assured, or ‘sure thing’, incentives and objective behavioural assessment in particular appear to moderate incentive effectiveness. As well, previously sedentary adults responded favorably to incentives 100% of the time (n=4).

Conclusions: The effect estimate from the meta-analysis suggests that financial incentives increase exercise session attendance for interventions up to six months in duration. Similarly, a simple count of positive (n=8) and null (n=3) effect studies

suggests that financial incentives can increase exercise adherence in adults in the short-term (< 6 months).

3.2 Introduction

According to the World Health Organization, behavioural risk factors including tobacco use, poor diet and physical inactivity account for an estimated 80% of chronic diseases (Organization 2014). Regular exercise in particular protects against debilitating and costly chronic conditions. Most adults are not sufficiently active, however, with less than 5% of U.S. adults accumulating the required dose of exercise to maintain health (Troiano et al. 2008). For many adults, the “costs” of exercise (e.g., time, uncomfortable feelings) loom so large that they never start (Biddle and Mutrie 2008). For those who do manage to start exercising, most dropout within six months (Biddle and Mutrie 2008). Low exercise adherence, therefore, is operationally defined as a problem of both initiation *and* maintenance. Recognizing that exercise is a complex behaviour influenced by multiple factors, a broad social-ecological approach requiring action across multiple domains is likely needed to address these issues. The economic domain has become an increasingly popular target for intervention (Rice 2013).

Behavioural economics, a branch of economics complemented by insights from psychology, has motivated renewed interest in economic-based, population-level health interventions (Rice 2013). Germany, the U.K. and U.S., South Africa and Canada, as well as several large corporations in the U.S., have adopted financial incentive-based public health and workplace wellness policies in recent years (NBSGH 2010; Ries 2012; Sturm et al. 2013). By acknowledging psychological tendencies that underlie decision making, behavioural economics offers a descriptively accurate portrait of human behaviour and is thus a strong theoretical foundation from which to generate practical techniques for promoting behaviour change. Behavioural economics acknowledges that human judgments are biased in systematic ways, and that these biases can make it difficult for people to make self-beneficial choices (Camerer and Loewenstein 2003). For example “present bias” refers to the tendency to act in favor of one’s immediate self-interest at the expense of one’s long-term well-being; in other words, immediate costs and benefits exert disproportionate influence on people’s choices relative to those that will be experienced some time in the future (Camerer and Loewenstein 2003). In the case of exercise, the “costs” are experienced in the present; whereas the benefits (e.g., health,

more attractive appearance) are delayed, resulting in notorious resolutions to “exercise more tomorrow”. According to behavioural economics, increasing the immediately rewarding aspects of exercise (e.g., by offering financial incentives such as cash or vouchers) may increase people’s propensity to exercise.

A growing body of evidence broadly supports this line of reasoning. For example, systematic reviews suggest that financial incentives generally improve ‘lifestyle’ health behaviours, including dietary behaviours, smoking cessation and weight loss, in the short-term (e.g., less than 6 months) and while the incentives are still in place (Wall et al. 2006; Paul-Ebhohimhen and Avenell 2008; Cahill and Perera 2011; Burns et al. 2012). These favorable effects have been largely short-lived however, with individuals usually reverting to baseline behaviours soon after the incentive is removed (Wall et al. 2006; Paul-Ebhohimhen and Avenell 2008; Cahill and Perera 2011; Burns et al. 2012).

Unfortunately, there has been less study of the impact of financial incentives on exercise specifically – arguably the behaviour most closely associated with health and longevity (Blair et al. 1989; Ross and Janiszewski 2008). Separating the effect of incentives on exercise from their effect on weight loss is important since incentive effectiveness is believed to be moderated by the behaviour/outcome targeted (Jeffery et al. 1993; Wing et al. 1996; Charness and Gneezy 2009). According to Jeffery *et al.* (1993, 1998), Wing *et al.* (1996) and Charness & Gneezy (2009), for instance, incentives contingent on an immediate, directly observable behaviour (e.g., exercise) may produce different effects than rewards contingent on distal consequences of behaviour (e.g., weight loss).

Similarly, in their review of incentives for weight loss, Paul-Ebhohimhen & Avenell (2008) observed “a very weak trend...in favor of reward for behaviour change than reward for weight.” Learning more about the effects of incentives on weight-related behaviours, such as exercise, and not just outcomes, may optimize incentive interventions in the future.

The primary objective, then, was to conduct a systematic review to determine if financial incentives increase exercise adherence in adults in the short-term (as has been observed previously with non-exercise ‘lifestyle’ health behaviours), and importantly, whether this increase can be sustained over the long-term (≥ 6 months is typically considered

‘maintenance’ within the Transtheoretical Model of Behaviour Change) (Prochaska and DiClemente 1992) *and* after the financial incentive is removed. A secondary objective was to explore financial incentive design features that may moderate effectiveness.

3.3 Methods

3.3.1 Electronic search

A sensitive systematic search strategy was developed for Medline (Appendix A) and modified for 14 other databases (Appendix B). Databases were searched in June 2012 for English-language RCTs published in peer-reviewed journals from inception to June 2012. The Cochrane Database of Systematic Reviews was also searched. Eight international experts with a recent and relevant publication history were contacted to review the list of included studies for missing papers (Appendix C). In addition, the highest yielding database (i.e. Medline) was searched a second time in January 2013. Reference lists of all included studies were hand searched as were relevant financial incentive-related reviews and articles.

3.3.2 Eligibility criteria

Studies of RCTs reporting the impact of financial incentives on exercise in adults (≥ 18 years) where incentives were contingent on a pre-specified exercise behaviour or outcome were included (e.g., exercise session attendance, aerobic fitness). Non-randomized studies where it was not possible to isolate the effects of incentives from other intervention components were excluded. Financial incentives were defined as any cash or non-cash reward with a monetary value (not items with negligible monetary value e.g., ribbons) provided directly to individuals. Where monetary value of financial incentives is not explicit, general statements (e.g., ‘day off work’) were extracted. Studies evaluating the impact of subsidies (e.g., tax credits) and disincentives (e.g., fiscal penalties) were excluded. In studies examining multiple treatments, groups differing only in the provision of financial incentives were compared. As well, studies providing financial incentives for multiple behaviour changes, for instance improved diet, smoking cessation and increased exercise, were included if exercise adherence was tracked throughout the intervention, or if aerobic fitness was measured at baseline and follow-up.

3.3.3 Study selection

Article records were independently screened by two reviewers (MM, JL) using a pilot tested *a priori* screening form (Appendix D). Where there was uncertainty, a third reviewer was consulted and made the final decision regarding inclusion (GF). Full texts of articles deemed potentially eligible were retrieved. One reviewer screened the full text articles for eligibility (MM) and another reviewer (GF) was consulted when it was unclear if a study should be included. Final decisions were made by consensus. The paper by Charness & Gneezy (2009) reports the results of two separate studies, both of which were included in the analysis (Charness and Gneezy 2009). In addition, two observations (i.e. treatment group #1 and #2) were extracted from Epstein et al. (1980, #1, #2). Reasons for study exclusion are presented in the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) guidelines flow chart (Figure 3.1) (Moher et al. 2009).

3.3.4 Quality of evidence

Two authors (MM, GF) independently applied the Effective Public Health Practice Project (EPHPP) Quality Assessment Tool for Quantitative Studies (QATool) to the included studies (EPHPP 1998). All studies meeting the inclusion criteria were included in the analysis, regardless of their quality rating.

3.3.5 Data analysis

Outcomes were not comparable enough to pool data (i.e. energy expenditure, aerobic fitness, exercise session attendance, aerobic minutes). A sufficient number of studies (more than two), however, reported the same outcome (i.e. exercise session attendance) to undertake a meta-analysis of a sub-sample of included studies (April 2013). Means and standard deviations were extracted and expressed in percent sessions attended in order to control for varying attendance expectations (e.g., 2 per week, 4 per week, etc.). Percent sessions attended were pooled using a weighted mean difference. Heterogeneity was explored using the impact of heterogeneity statistic (I^2). Where $I^2 \leq 50\%$ and $I^2 > 50\%$, fixed effects model and random effects model approaches were used, respectively. Sensitivity analyses including and excluding studies with a high risk of bias (EPHPP

‘weak’ quality rating) were conducted. Analyses were conducted in Review Manager 5.2 (The Cochrane Collaboration).

The small number of studies included in the meta-analysis ($n < 10$) made it inappropriate to examine relationships between clinical characteristics (e.g., incentive design features) and the direction, size or duration of the intervention effect using meta-regression. As well, too few studies reporting exercise session attendance examined incentive effectiveness for more than six months ($n = 1$) and in the post-intervention period ($n = 2$) to stratify studies based on these variables in sub-group analyses. For these reasons, a qualitative analysis of the data was conducted (February 2013).

The purpose of the qualitative analysis, structured along the seven published features of financial incentive design (each possessing a range of attributes; see Table 5.1) (Klein and Karlawish 2010) was to explore the impact of incentive design features on intervention effectiveness. Based on a review of the literature, Klein & Karlawish (2010) proposed the seven features to facilitate the design of financial incentive programs for different sub-populations. These features are the first set to comprehensively list and define financial health incentive program components and are a valuable incentive design and evaluation resource. Even subtle changes to these features have rendered incentives ineffective in the past (e.g., requiring monetary deposits can limit incentive program participation) (Volpp et al. 2011), highlighting the importance of considering each in this review. Minor adjustments to these features are recommended (e.g., re-imburement-type incentive was added as a distinct feature attribute). One new design feature was also added to cover an additional facet of incentive design (Type of assessment; Table 5.1). Study characteristics, study quality appraisal, and financial incentive design features are summarized in Appendix E (more than two pages), Table 3.2 and Table 3.3.

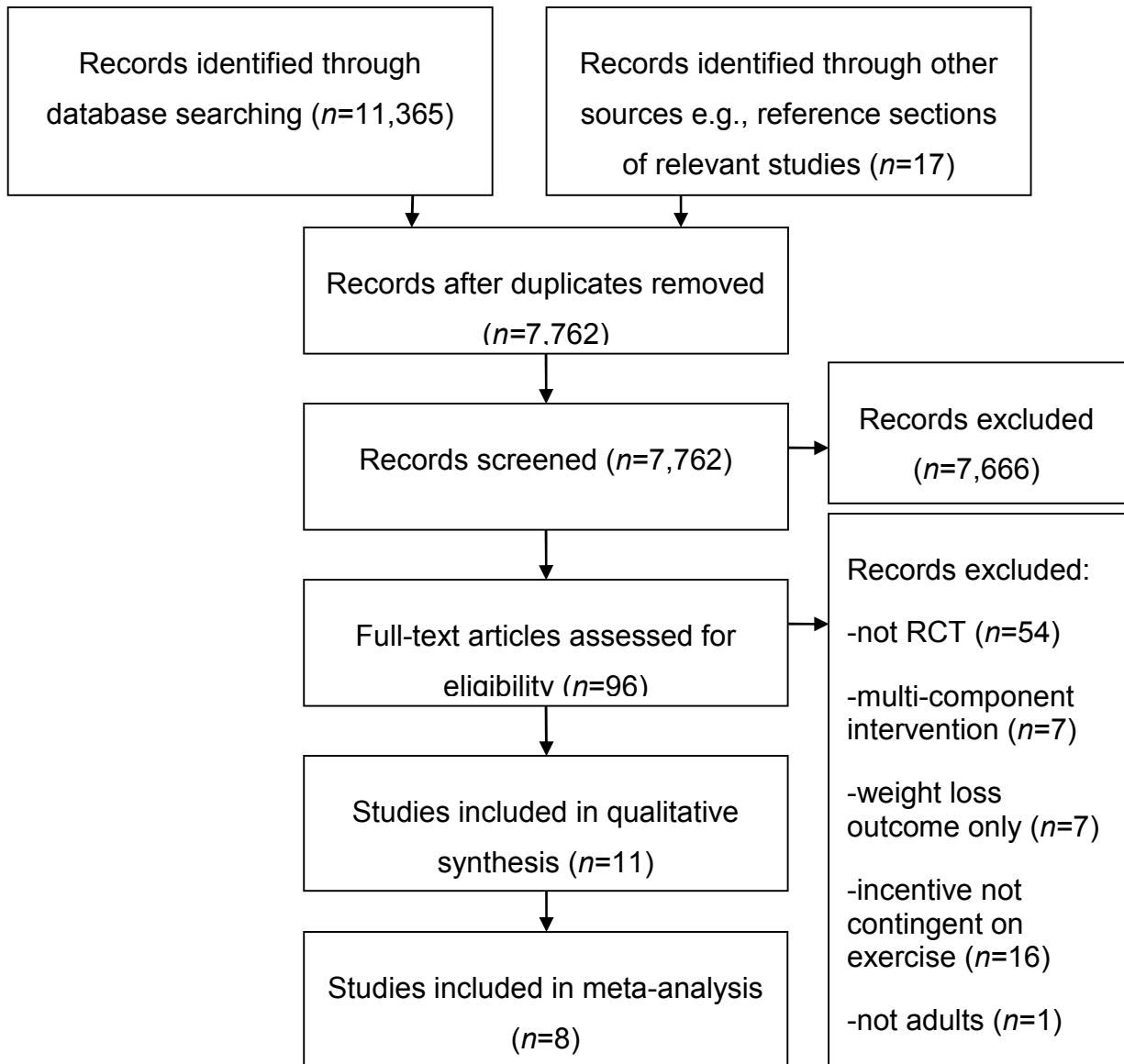


Figure 3.1. Flowchart of included and excluded studies examining the impact of incentives on exercise in adults.

3.4 Results

3.4.1 Study characteristics

From an initial return of 7,762 articles (after de-duplication), 96 full texts were assessed for eligibility and 11 met our inclusion criteria (Epstein et al. 1980; Noland 1989; Gomel et al. 1993; Wing et al. 1996; Courneya et al. 1997; Jeffery et al. 1998; Jeffery and French 1999; Finkelstein et al. 2008; Charness and Gneezy 2009; Daryanto et al. 2010). Five studies were retrieved using Medline and seven from other sources (i.e. hand searching). Characteristics of included studies are presented in Appendix E. Eligible studies with a cumulative sample of 1,453 healthy, community-dwelling adult participants (18-85yrs; approximately 50% female and 40% overweight) were published between 1980 and 2010. The sample size of included studies ranged from 15 to 395. Only one study reported income level (Finkelstein et al. 2008) and the psychological variables that may mediate sustained behaviour change, such as self-efficacy or intrinsic motivation, were not assessed in any study.

3.4.2 Quality of evidence

Three (Epstein et al. 1980; Noland 1989; Daryanto et al. 2010), six (Wing et al. 1996; Jeffery et al. 1998; Jeffery and French 1999; Finkelstein et al. 2008; Charness and Gneezy 2009), and two studies (Gomel et al. 1993; Courneya et al. 1997) were assigned weak, moderate and strong quality ratings, respectively. Among those studies rated moderate, selection bias (on the basis that participants were recruited by media advertisement/email lists) lowered the quality rating on each occasion. Quality of evidence is summarized in Table 3.2.

Table 3.2: Study quality rating using Effective Public Health Practice Project Quality Assessment Tool for Quantitative Studies.

Author, Year	Overall Rating	Selection Bias	Study Design	Confounders	Blinding	Data Collection Methods	Withdrawals & Dropouts
<i>Epstein, 1980</i>	Weak	Weak	Strong	Weak	<i>Moderate</i>	Strong	Strong
<i>Noland, 1989</i>	Weak	Weak	Strong	Weak	Weak	Strong	Strong
<i>Gomel, 1993</i>	Strong	Strong	Strong	Strong	<i>Moderate</i>	Strong	Strong
<i>Wing, 1996</i>	<i>Moderate</i>	Weak	Strong	Strong	<i>Moderate</i>	Strong	Strong
<i>Courneya, 1997</i>	Strong	Strong	Strong	Strong	Strong	Strong	Strong
<i>Jeffery, 1998</i>	<i>Moderate</i>	Weak	Strong	Strong	Strong	Strong	<i>Moderate</i>
<i>Jeffery, 1999</i>	<i>Moderate</i>	Weak	Strong	Strong	Strong	<i>Moderate</i>	<i>Moderate</i>
<i>Finkelstein, 2008</i>	<i>Moderate</i>	Weak	Strong	Strong	Strong	Strong	<i>Moderate</i>
<i>Charness, 2009a</i>	<i>Moderate</i>	Weak	Strong	Strong	Strong	Strong	Strong
<i>Charness, 2009b</i>	<i>Moderate</i>	Weak	Strong	Strong	Strong	Strong	Strong
<i>Daryanto, 2010</i>	Weak	Weak	Strong	Weak	Strong	Strong	Strong

3.4.3 Meta-analysis of sub-sample of studies with similar outcomes

Seven studies (eight observations between four and 26 weeks; N=554) reported mean exercise session attendance and results were pooled in a meta-analysis. Due to heterogeneity between the studies ($\text{Chi}^2 = 280.55$, $\text{df} = 7$ ($P < 0.00001$); $I^2 = 98\%$) sensitivity analyses excluded ‘weak’ quality as well as outlying studies. Excluding the ‘weak’ quality studies (Epstein et al. 1980; Daryanto et al. 2010) did not reduce heterogeneity ($\text{Chi}^2 = 250.37$, $\text{df} = 4$ ($P < 0.00001$); $I^2 = 98\%$). In a separate sensitivity analysis excluding the outlying studies (Charness & Gneezy 2009ab), heterogeneity was reduced considerably ($\text{Chi}^2 = 2.05$, $\text{df} = 5$ ($P = 0.84$); $I^2 = 0\%$). The incentives in these outlier studies were the largest among included studies (i.e. \$33.54 to 46.82 per week; see

Table 3.3), possibly explaining their pronounced effect on exercise session attendance. Even after removing the outliers, pooled results for exercise session attendance over a period of four to 26 weeks favored the incentive condition; the use of financial incentives was associated with an increase in exercise session attendance of 11.55% (95% CI, [5.61,17.50]%; $Z = 3.81$, $P < 0.0001$; see Figure 3.2). The effect estimate persisted after removing studies at high risk of bias from the meta-analysis (weighted mean difference 11.75%, 95% CI [4.60,18.96]%, $Z = 3.22$, $P < 0.001$).

Figure 3.2. Exercise session attendance (%; four to 26 weeks) comparing use of incentives versus no incentives (IV = Inverse variance). *Note: The Charness 2009 paper reported on two studies, so results are reported for each.*

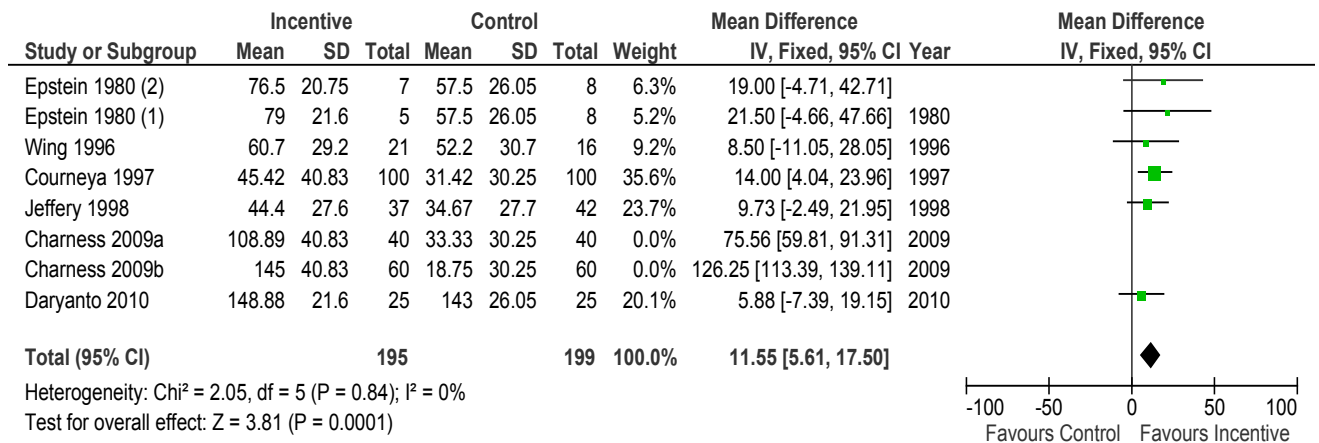


Table 3.3: Incentive design feature attributes of included studies.

Author, Year, Country	Type	Quantity^a	Probability	Timing	Participant investment	Info. Disc.	Dispensing type	Type of assessment
<i>Epstein, 1980, U.S.</i>	1)Cash, 2)Cash	1)Indexed, \$11.70 2)Indexed, \$2.79	1)Chance 2)Assured	1)Assessed weekly; incentive delayed 5 weeks 2)Assessed weekly; incentive at 1 week	1)Escrow, \$3 deposit 2)Escrow, \$5 deposit	Fact.	1)Aggregative 2)Reset	Objective, direct, behavioural assessment
<i>Noland, 1989, U.S.</i>	Non-cash	Uniform, ~\$0 to \$92.58	Assured	Assessed at set intervals/ program completion; incentive within 1 week of assessment.	Opportunity cost	Fact.	Aggregative	Self-reported behaviours/ aerobic fitness outcome
<i>Gomel, 1993, U.S.</i>	Non-cash	a)Indexed, \$12.71 b)Uniform, \$5.29 c)Uniform, \$2.78	a)Chance b)Assured c)Chance	Assessed weekly/3, 6 months; incentive delayed > 1 week after assessment	Opportunity cost	Fact/ Coun	a)Aggregative b)Reset c)Aggregative	Self-reported behaviours/ aerobic fitness outcome
<i>Wing, 1996, U.S.</i>	Non-cash	a)Indexed, \$73.17 b)Indexed, \$121.94	a)Chance b)Chance	Assessed weekly; weekly and delayed incentives.	Opportunity cost	Fact/ Coun	a)Aggregative b)Aggregative	Objective, direct, behavioural assessment
<i>Courneya, 1997, Canada</i>	Reimb.	Uniform, \$17.76	Assured	Immediate assessment; incentive at end	Opportunity cost	Fact.	Aggregative	Objective, indirect, behavioural

				of month.				assessment
<i>Jeffery, 1998, U.S.</i>	Cash	Indexed, Escalating, \$9.61	Assured	Immediate assessment; incentive at 1 month intervals.	Opportunity cost	Fact.	Aggregative	Objective, direct, behavioural assessment
<i>Jeffery, 1999, U.S.</i>	Cash	Indexed, \$34.45	Chance	Assessment upon receiving post-card in mail; incentive within week.	Opportunity cost	Fact.	Aggregative	Self-reported behaviours
<i>Finkelstein, 2008, U.S.</i>	Cash	Escalating, \$39.99 - includes one-time payment of \$53.48 for initial study enrollment.	Assured	Daily/weekly assessment; incentive at study end (1 month).	Opportunity cost	Fact.	Reset	Self-reported behaviours/ Objective indirect, behavioural assessment
<i>Charness, 2009a, U.S.</i>	Cash	1)Uniform, \$26.75 2)Uniform, \$33.54	1)Assured 2)Assured	Immediate assessment; incentive at intervention end.	Opportunity cost	Fact.	1)Aggregative 2)Aggregative	Objective, indirect, behavioural assessment
<i>Charness, 2009b, U.S.</i>	Cash	1)Uniform, \$46.82 2)Uniform, \$46.82	1)Assured 2)Assured	Immediate assessment; incentive at intervention end.	Opportunity cost	Fact.	1)Aggregative 2)Aggregative	Objective, indirect behavioural assessment
<i>Daryanto, 2010a, U.K.</i>	Reimb.	Uniform, €2.71	Assured	Immediate assessment; incentive at intervention end.	Opportunity cost	Fact.	Aggregative	Objective, indirect, behavioural assessment

3.4.4 Qualitative synthesis of all included studies using ‘vote counting’

A simple count of positive (n=8) and null effect (n=3) studies suggests that financial incentives can increase exercise adherence in adults. While it appears that incentives differentially impact classes of behaviour (e.g., increase in exercise session attendance, but not overall physical activity level), a closer examination helps to explain disparate findings (e.g., poor intervention designs, inadequate outcome measures) (Jeffery et al. 1993; Jeffery and French 1999). Among the studies demonstrating significant, positive effects, three received a weak quality rating (and thus at high risk of bias) (Epstein et al. 1980; Noland 1989; Daryanto et al. 2010), four moderate (Jeffery et al. 1998; Finkelstein et al. 2008; Charness and Gneezy 2009) and one strong (Courneya et al. 1997). Notably, six out of the eight positive studies tested financial incentive effectiveness in the short-term only (≤ 3 months) (Epstein et al. 1980; Courneya et al. 1997; Finkelstein et al. 2008; Charness and Gneezy 2009; Daryanto et al. 2010). Among the three studies monitoring exercise adherence after incentives were withdrawn (Gomel et al. 1993; Charness and Gneezy 2009), two demonstrated persisting levels of adherence, but only for the previously inactive (Charness and Gneezy 2009). The previously active adults (i.e. those who were exercising regularly at baseline) exhibited a drop in attendance following the intervention (Charness and Gneezy 2009). For the studies showing a null effect (N=609), two were rated moderate (Wing et al. 1996; Jeffery and French 1999) and one was rated strong (Gomel et al. 1993).

3.4.5 Design feature attributes of studies demonstrating positive and null effects

Design feature attributes for included studies are summarized in Table 3.3. While financial incentive designs varied considerably between studies, several attributes appear to distinguish positive from null effect studies. First, seven out of the eight positive studies rewarded objectively assessed behaviours (i.e. supervised exercise session attendance (n=2) (Epstein et al. 1980; Jeffery et al. 1998); computerized gym attendance (n=4) (Courneya et al. 1997; Charness and Gneezy 2009; Daryanto et al. 2010); aerobic

minutes by pedometer (n=1) (Finkelstein et al. 2008). This was not the case for two out of the three null effect studies, where financial incentives were contingent on self-reported behaviours (Gomel et al. 1993; Jeffery and French 1999). Next, while 75% of studies (three out of four) implementing chance-, or lottery-based, financial incentives (whether exclusively or combined with an assured incentive) did not increase exercise adherence (Gomel et al. 1993; Wing et al. 1996.; Jeffery and French 1999) all of the studies (seven out of seven) offering assured, or ‘sure thing’, financial incentives produced a favorable effect (Noland 1989; Courneya et al. 1997; Jeffery et al. 1998; Finkelstein et al. 2008; Charness and Gneezy 2009; Daryanto et al. 2010). As well, 100% of interventions targeting previously inactive adults yielded a positive effect (n=4) (Noland 1989; Finkelstein et al. 2008; Charness and Gneezy 2009).

Larger incentives (i.e. \$26.75-\$46.82 per week) appeared to yield larger effects (Finkelstein et al. 2008; Charness and Gneezy 2009). Financial incentive magnitude, however, ranged from \$2.79 to \$46.82 per week for positive studies suggesting that even modest incentives (when combined with more potent feature attributes) may increase exercise adherence in adults. While limited by the extant literature, several promising design feature attributes were identified in this review. In particular, incentive schemes incorporating indexed/escalating incentives (Jeffery et al. 1998; Finkelstein et al. 2008), cash (Epstein et al. 1980; Jeffery et al. 1998; Finkelstein et al. 2008; Charness and Gneezy 2009)/re-imbusement-type incentives (Courneya et al. 1997; Daryanto et al. 2010), and escrow incentives (Epstein et al. 1980) (i.e. deposit contracts) may optimize effectiveness (see Table 5.1 for attribute definitions) (Volpp et al. 2011). Notably, the majority of the positive studies dispensed incentives at the end of the intervention period (aggregative dispensing type), rather than with each achievement (reset dispensing type), suggesting that the immediacy of the tangible incentive may not be critical if participants are promptly and regularly informed of their reward ‘status’. Since 10 out of the 11 included studies offered aggregative incentives, though, it is not known whether more immediate, reset incentives would have increased intervention effectiveness. Lastly, in the one study reporting personal income data (Finkelstein et al. 2008), lower income adults (< \$50,000 2008 U.S. dollars) accumulated more aerobic minutes than their higher

income counterparts (> \$50,000 2008 U.S. dollars) in the presence of a financial incentive contingency.

3.5 Discussion

The best effect estimate from the meta-analysis suggests that financial incentives increase exercise session attendance for interventions short in duration (i.e. four to 26 weeks) by approximately 11.55 (4.60 - 18.96) %. Similarly, among all the included studies (studies reporting various exercise-related outcomes, not just exercise session attendance), a simple count of positive and null effect studies suggests that financial incentives increase exercise in adults in the short-term. This is consistent with findings from previous systematic reviews that generally observed improved dietary behaviours (Wall et al. 2006), smoking cessation (Cahill and Perera 2011), and weight loss (Paul-Ebhohimhen and Avenell 2008), respectively, in the short-term and while financial incentives remained in place. The applicability of this overall finding is limited, however, by the homogeneity of study population characteristics and the wide range of incentive design feature attributes in the included studies. Vulnerable groups (e.g., chronic disease, low SES populations) in particular were under-represented in the included studies limiting the generalizability of the results to predominantly young, white, healthy, and educated U.S. adults. As well, given the scarcity of research examining incentives for exercise, there is insufficient data to draw conclusions regarding the influence of incentive design features and contextual factors (e.g., income level baseline activity levels) on incentive effectiveness.

Similarly, there is limited evidence to draw conclusions regarding longer-term incentive interventions (> 6 months). Indeed, the majority of the studies demonstrating a positive effect did so in the short-term only (n=6; four to 12 weeks) (Epstein et al. 1980; Courneya et al. 1997; Finkelstein et al. 2008; Charness and Gneezy 2009; Daryanto et al. 2010). Financial incentives did sustain exercise adherence for more than a year in one study, however, underscoring the *potential* for incentives to promote exercise maintenance (Jeffery et al. 1998). In this study, Jeffery *et al.* (1998) offered assured, indexed and escalating cash incentives (worth \$9.61 per week) for objectively assessed walking session attendance. This combination of feature attributes may have increased

the ‘perceived value’ of the incentive enough to stimulate sustained exercise. Indexed and escalating financial incentive schedules (i.e. \$1 for first 10 walks, \$1.50 for next 10, etc.) in particular have promoted continued financial incentive program participation in the past (Jeffery et al. 1984; Higgins et al. 1991) and have recently been used to promote gym attendance among first-year college students (Pope and Harvey-Berino 2013). In addition to demonstrating the potential long-term effectiveness of financial incentives, Jeffery *et al.* (1998) make a novel contribution to the literature given the sometimes cited “habituation” effect of continuous incentive intervention, where financial incentive effectiveness deteriorates as individuals become familiarized with the external motivator (Burns et al. 2012; Jeffery 2012). Concluding that financial incentives drive long-term exercise, however, is premature given that only one RCT has demonstrated their long-term effectiveness.

The dearth of research exploring the post-intervention effects of incentive intervention, arguably the most important gap in the literature, precludes conclusions regarding the sustained effectiveness of time-limited incentive interventions. While acknowledging the very limited amount of research in this area, lessons may be learned from the only positive studies measuring exercise in the critical post-incentive period. Charness & Gneezy (2009ab) found that the increase in gym attendance observed among university students persisted for five and 16 weeks, respectively, following separate five week interventions (i.e. assured, aggregative cash incentives valued at \$26.75 to \$46.82 per week and contingent on prompt, objective behavioural assessment) (Charness and Gneezy 2009) – a notable finding given that the most commonly reported weakness of financial incentive intervention is the potential for new, external motivators to depress intrinsic motivation and harm, rather than sustain, post-intervention behaviours. Indeed, there is strong evidence to support this so-called “crowding out” effect (Deci et al. 1999; Burns et al. 2012; Moller et al. 2012). Such a possibility is in line with self-determination theory (SDT) which would suggest that rewarding individuals for participating in potentially intrinsically interesting tasks may reduce intrinsic motivation once the financial incentive is no longer offered (Deci and Ryan 1985). Interestingly, according to Charness & Gneezy (2009ab), the risk of undermining intrinsic motivation may be lower for financial incentives targeting previously *inactive* adults. This is likely because

inactive adults have lower levels of intrinsic motivation to exercise to begin with (Biddle and Mutrie 2008).

In addition to considering physically inactive populations as the initial targets for intervention, future research should examine how the features of financial incentive programs could be manipulated to maintain or increase, rather than harm, intrinsic motivation. SDT provides a valuable theoretical framework to consider when designing incentive interventions with this aim. According to SDT, intrinsic motivation is in part shaped by the extent to which individuals fulfill the basic psychological needs of competence (experiencing mastery), autonomy (a sense of ownership over behaviour) and social relatedness (feeling socially connected to others) (Deci and Ryan 1985). By rewarding the achievement of *realistic* self-regulatory goals (e.g., exercise self-monitoring), for example, or by providing choice (e.g., Which vouchers would you prefer?) or rewards related to social outcomes (e.g., group contingencies or charitable donations) (Mitchell and Faulkner 2012), incentives may serve to fulfill these basic psychological needs and maintain or increase intrinsic motivation. These theoretically-promising ‘manipulations’, however, require empirical support before widespread recommendation.

3.6 Implications

Western nations and corporations are implementing financial incentive-based public health and workplace wellness policies with much greater frequency. This review supplies decision makers with a summary of the current state of the literature examining the impact of financial incentives on exercise adherence in adults. Financial incentives appear to increase exercise adherence in adults in the short-term. Larger, assured, indexed and cash or re-imburement-type incentives contingent on objectively assessed behaviours may optimize incentive interventions. However, in the absence of research that directly compares design feature attributes (e.g., assured vs. chance incentives, cash vs. non-cash incentives, incentives for behaviours vs. outcomes - with all other features held constant) recommendations cannot be made. In addition, too few studies have examined the longer-term and post-intervention effects of financial incentive intervention on exercise adherence to draw conclusions. One and two RCTs, respectively, though,

demonstrate the potential for incentives to drive long-term behaviour change as well as to sustain exercise after incentives are withdrawn. Incentive design feature attributes possibly promoting these novel effects were noted. In particular, escalating incentives may offer a practical approach to counteract the sometimes-cited “habituation” effect of incentive intervention. As well, while much research is still needed to determine for whom financial incentives are most appropriate, the literature suggests that physically inactive adults should be initial intervention targets. Not only may inactive adults be more likely to increase the amount of exercise they do in the presence of an incentive contingency, but they may be more likely to sustain their exercise after the incentive is removed (Charness and Gneezy 2009). Similarly, interventionists should be wary of incentivizing current exercisers given the potential to harm intrinsic motivation and decrease post-intervention exercise (Lunze and Paasche-Orlow 2013). Clearly, more research is required to elucidate the conditions under which financial incentives both stimulate *and* sustain exercise.

3.7 Future research

RCTs in the ‘lifestyle’ health behaviour change arena (e.g., exercise, smoking) should prioritize evaluation in the critical post-incentive period, including tracking the psychological variables known to mediate sustained incentive effectiveness (e.g., self-determined motivation, self-efficacy). In addition to deploying behavioural economics *and* SDT (to stimulate exercise *without eroding intrinsic motivation*), the follow-up periods for these studies should be long enough to detect behavioural decay. Studies should also assess how theoretically-promising design feature attributes impact longer term incentive program engagement, including: indexed, escalating and random (vs. uniform) incentive distribution patterns, random (vs. set) assessment/reward intervals (e.g., frequent and regular initially, infrequent and irregular as time passes), combination individual/group (vs. individual only) contingencies, incentives for incremental change (e.g., to promote early success, increase self-efficacy) as well as for self-regulatory behaviours (i.e. behavioural ‘stepping stones’). Of interest to governments and corporations is the minimum incentive amount required to elicit meaningful change for different behaviours and/or outcomes and for different sub-populations. The potential for

novel feature attributes to drive the minimum threshold down, such as re-imburement type incentives (e.g., gym, public transit re-imburements) (Martin et al. 2012), desirable voucher incentives (e.g., from a range of participant driven options) (Hunter et al. 2013), and reset (rather than aggregative) incentives should be explored. Advances in mobile health (mHealth) technology, coupled with the pervasiveness of mobile phones in general, may also be leveraged to more promptly assess and reward behaviours on a population scale, further reducing the need for prohibitively costly incentives. Learning more about how incentive design features can be manipulated for different sub-populations (e.g., by matching feature attributes to individual/group characteristics) may increase intervention effectiveness while lowering intervention costs as well.

3.8 Limitations

Our search strategy was limited to English only studies so language bias might be present. Additionally, there is potential for publication bias given our reliance on searching electronic databases which may miss relevant grey literature. Attempts to minimize such bias were made by hand searching reference sections of relevant articles, as well as by engaging international experts to provide feedback on the included studies. Given their greater potential for selection bias, we excluded all non-randomized studies and this did limit the number of studies included in the review.

3.9 Conclusion

Collectively, the included studies highlight the potential role of even modest financial incentives in promoting exercise initiation and maintenance in adults. More research is warranted that explores the conditions under which financial incentives are likely to drive long-term, post-incentive exercise adherence. Careful attention should be paid to the incentive design features highlighted in this review. In particular, characteristics of target groups (e.g., income level, baseline activity levels) must be considered. As well, broader theoretical considerations regarding how rewards motivate human behaviour may help to address concerns regarding the potential for poor post-incentive exercise adherence.

3.10 Acknowledgements

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Chapter 4

4 'Will walk for groceries': Acceptability of financial health incentives among Canadian cardiac rehabilitation patients

4.1 Abstract

Financial health incentives, such as paying people to exercise, remain controversial despite widespread implementation. This focus group study explored the acceptability of incentives among a sample of Canadian cardiac rehabilitation (CR) patients (n=15). Focus groups were conducted between March and April 2013 until further sampling ceased to produce new analytical concepts. A thematic analysis approach was adopted in analyzing the data. Three broad themes emerged from the focus groups. First, ethical concerns were prominent. Half of participants disagreed with the incentive approach believing that it was unfair, unnecessary or a waste of limited resources. Second, ethical concerns were mitigated in considering a range of incentive features including type, size and source. Specifically, privately sponsored (not government funded) health-promoting voucher-based incentives (e.g., grocery or gym vouchers) were perceived to be highly acceptable. Third, if designed like this then financial incentives were considered potentially effective in motivating behaviour change and in reducing economic barriers to exercise participation. Overall, the majority of participants welcomed incentives if ethical concerns were addressed through thoughtful incentive program design. The results of this focus group study will inform the design of a financial health incentive feasibility RCT to promote post-CR program exercise compliance in this population.

4.2 Introduction

Financial health incentives, such as paying people to exercise, are increasingly being implemented by governments and corporations to promote healthy behaviours and curb rising health care costs (Ries 2012; Schmidt et al. 2012). Despite widespread implementation, public opinion regarding incentives remains split with about half of survey respondents agreeing, and half disagreeing, with the approach (Long et al. 2008; Priebe et al. 2010; Bonevski et al. 2011; Lynagh et al. 2011; Promberger et al. 2011; Bonevski et al. 2012; Park et al. 2012; Park et al. 2012; Promberger et al. 2012). For example, in a recent survey of 383 socially disadvantaged Australian adults, Bonevski *et al.* (2012) found that only half of respondents (46%) believed incentives for smoking cessation were an excellent/good idea.

In addition to the questions of effectiveness that often pit supporters from detractors (e.g., Do incentives work? Do they drive *sustained* behaviour change?), ethical concerns regarding fairness (e.g., Why should *they* be rewarded?), opportunity cost (e.g., Could the money be better spent?), and coercion/bribery (e.g., I don't like the government telling me what to do.) may provoke strong reactions. Especially during uncertain economic times, the prospect of spending limited government resource on largely unproven public health approaches may be viewed as inappropriate. For many, the costs of incentive intervention (e.g., opportunity cost) simply outweigh the purported benefits (e.g., improved public health). While the evidence suggests incentives can significantly improve health behaviours in certain contexts (e.g., incentives that are large enough and that target receptive populations) (Cahill and Perera 2011; Burns et al. 2012; Mitchell et al. 2013), in the absence of public support, and target group 'acceptability' in particular, intervention effectiveness may be limited (Fong et al. 2006; Volpp et al. 2011).

Given that target group acceptability is a likely pre-condition to successful incentive intervention, gauging target group opinions in advance of implementation appears essential. Since the authors of this study plan to conduct a pilot RCT to establish the feasibility of an incentive intervention in a cardiac rehabilitation (CR) context, an exploration of the acceptability of incentives among CR participants is warranted. This study follows a systematic review of the evidence that suggests incentives can increase

exercise participation in adults (Mitchell et al. 2013) and aligns with the stages of intervention development defined by the Medical Research Council (i.e. Phase 1, ‘Modeling’). This is the first study to examine the acceptability of incentives in CR, a comprehensive outpatient program designed to help individuals recover from and manage their cardiovascular disease (CVD). With aerobic exercise as its cornerstone, CR has shown to improve CVD risk factors, prevent costly hospitalization, and reduce cardiac deaths by 50% (Lavie and Milani 2011). Exercise adherence among CR participants remains suboptimal, however, with up to 75% of program graduates failing to maintain their exercise after one year (Zullo et al. 2010). For this reason new approaches that promote the long-term continuation of exercise after CR are needed. CR in particular is an area ripe for incentive intervention given that regular exercise is often under behavioural control (Ades and Gaalema 2012; Mitchell and Faulkner 2012). In addition to being the first study to examine incentive acceptability in CR, it is also the first study to explore perceptions of incentives in the context of Canadian healthcare. In this focus group study, then, the aim is to describe and better understand the acceptability of incentives among a sample of Canadian CR patients. The extent to which common incentive design features moderate acceptability is also explored since these have influenced acceptability and uptake in the past (Long et al. 2008; Promberger et al. 2011; Bonevski et al. 2012).

4.3 Methods

A focus group methodology was used to explore a range of perspectives (Morgan 1996) regarding financial health incentive intervention in the context of CR. English speaking persons who had participated in a CR program for at least three months (of a six month program) were recruited from the Toronto Rehabilitation Institute. Focus groups of five-to-six patients were conducted between March and April 2013 until further sampling ceased to produce new analytical concepts. The research ethics boards of the University Health Network and the University of Toronto Research reviewed and approved this study.

4.3.1 Procedure and data collection

Focus groups were conducted by an experienced CR case manager who was actively engaged with CR participants and their concerns and who had over five years of facilitator experience. The facilitator presented a standardized set of questions (Figure 4.1) that were either adapted from existing items or specially-derived following a literature review. Notably, participants were asked whether the implementation of certain incentive ‘features’ (e.g., type, source, size of incentive) might influence their opinions regarding incentive intervention, providing a more nuanced account of incentive acceptability. A ‘structured’ focus group approach (e.g., standardized questions were posed and all patients were encouraged by the facilitator to participate) (Morgan 1996) was deliberately used to allow direct comparisons between groups. As well, by encouraging all participants to express their views, especially dissimilar ones, the facilitator attempted to reveal as many opinions as possible.

Figure 4.1. Pre-specified questions used to guide focus group discussion and source where there was one.

1. *“Some people think the health system should reward cardiac rehab graduates with cash (or cash-equivalents like vouchers or gift cards) for continuing to exercise after their rehab program. Others disagree. What do you think?”* (Long et al. 2008; Lynagh et al. 2011; Bonevski et al. 2012)
2. *“Now I’d like you to think of a hypothetical situation. If you were offered \$10 each week for three months to submit an exercise diary, would you be more or less likely to complete the diary?”*
3. *“Now asking the same question in a slightly different way, do you think others in the program would be more or less likely to complete/submit an exercise diary after they graduate if they were offered \$10 per week to do so?”*
4. *“What factors might influence your opinion (or the opinion of others in the program) regarding incentives?”*
 - a. Would incentive type influence your opinion? e.g., cash vs. grocery voucher, gym re-imburement, or charitable donation.
 - b. Would the size of the incentive influence your opinion? e.g., \$2 vs. \$50 per week.
 - c. Would the source of the incentive influence your opinion? e.g., health system vs. company you trust or private donation.
5. *“Would you actually enrol in a Rewards Program for cardiac rehab graduates, like the one we’ve talked about today?”*

Given that a financial health incentive intervention may be deemed a ‘sensitive topic’ (e.g., ‘If I say incentives are a good idea will people think I’m greedy, or that I need the money?’), and to reduce social desirability bias, the hypothetical situation presented in Question 2 (Figure 4.1) was re-framed to ask participants what they thought *other people* might do if offered an incentive program (Question 3 in Figure 1). Exercise self-monitoring (a self-regulatory, or ‘stepping-stone’, behaviour) rather than exercise *per se* was the target behaviour of interest given that incentives for self-monitoring are theorized

to promote sustained, post-incentive behaviour change (Mitchell and Faulkner 2012). As well, previous research suggests that 1.2% of personal disposable income (about \$10/week for someone making \$50,000/year) is a threshold above which incentives produce favourable ‘lifestyle’ health behaviour changes (Paul-Ebhohimhen and Avenell 2008) so \$10 per week was chosen as the size of the hypothetical incentive. The discussions were digitally recorded and transcribed by the facilitator. A rigorous and thorough orthographic transcript was produced (Braun and Clarke 2006).

4.3.2 Analysis

The six steps of thematic analysis, a method of identifying, analysing, and reporting patterns (themes) within data, as outlined by Braun and Clarke (2006) were undertaken, including: (1) familiarization of data, (2) generating initial codes, (3) searching for sub-themes/themes, (4) reviewing/refining sub-themes/themes, (5) defining/naming sub-themes/themes, and (6) producing the report. Since the purpose of this study was to explore opinions and generate ideas about opinion moderators, a *theoretically*-driven thematic analysis searching for semantic themes was undertaken. The theoretical (vs. inductive) approach was driven by the researchers’ theoretical and analytic interest in the area – namely, the overall acceptability of financial health incentive intervention among Canadian CR patients.

One researcher actively read and re-read the transcripts multiple times and independently defined a preliminary coding scheme. The first author’s Ph.D. supervisor repeated steps one to three to confirm and expand the identification of meaningful units or codes (‘chunks of data’ pertaining to our specific research question). There were no additional codes identified as a result of this review. Within this set of codes, a search for sub-themes followed. Coded data representing some level of *patterned* response were grouped into sub-themes which reflected something important about the data. If sub-themes cohered around a central concept and were similar in their relation to the overall question of acceptability, they were grouped together into broader themes. The approach to coding, and sub-theme/theme identification, refinement, naming and interpretation, was informed by the extant literature, since engagement with the literature can sensitize researchers to data subtleties (Tuckett 2005).

4.4 Results

A sample of 15 CR subjects (33% female; age range = 54-84 years), participated fully in three focus groups. The sample broadly reflected the demographic profile of Toronto Rehabilitation Institute's CR patients in general (see Table 4.1 for Population and Sample Characteristics), though comparing the groups using the full range of socio-demographic variable was not possible due to a lack of available data. Comprised of mostly (80%) Caucasian participants, two-thirds of the sample were married, retired, and reported personal annual income of less than \$50,000.

Table 4.1. Population and study sample characteristics.

	TRI*	Study sample
N=	685	15
Age, yrs (mean \pm SD)	63.8 \pm 12.2	65.0 \pm 8.6
Gender, female %	29.9	33.3
Body Mass Index (mean \pm SD)	28.7 \pm 5.2	30.5 \pm 4.6
Smoking, %	1.3	0
VO _{2peak} , ml/kg/min	17.9 \pm 6.0	17.9 \pm 2.8
MI/PCI as referring diagnosis, %	67.9	40.0
Diabetes (any), %	23.5	33.3

*Characteristics of Toronto Rehabilitation Institute (TRI) patient population from January 1, 2012 to June 30, 2012.

From the transcriptions, 20 codes were generated, which informed further analysis and the identification of nine sub-themes and three themes that linked back to the overall research question. The themes consisted of (1) 'Ethical concerns', (2) 'Incentive features moderating acceptability', and (3) 'Effectiveness', and are outlined in Figure 2.

Supporting verbatim statements for each sub-theme are also provided (Figure 4.2).

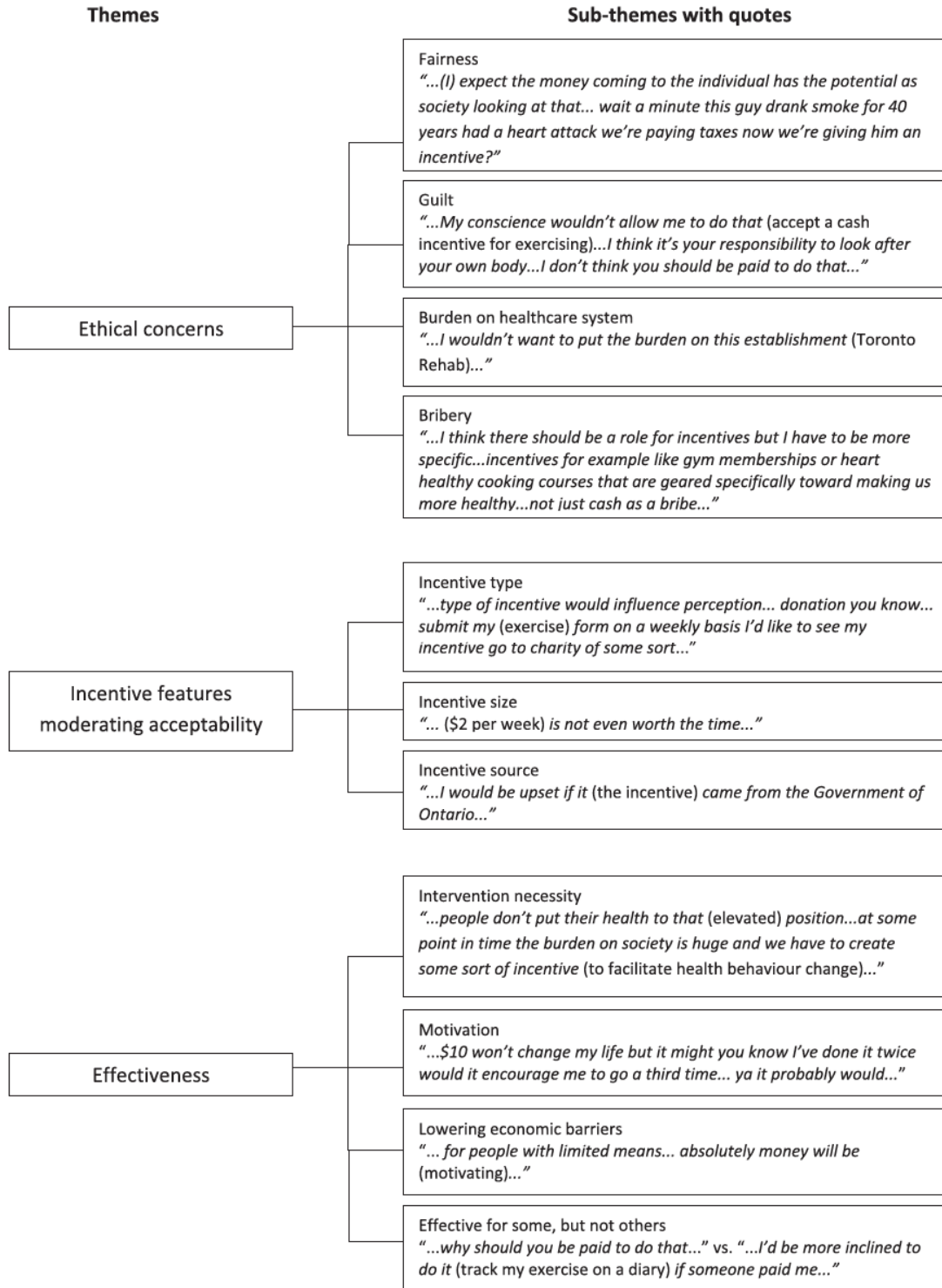


Figure 4.2 Themes, sub-themes and illustrating quotes.

4.4.1 Overall results

While participants varied along several (potentially mediating) demographic characteristics (e.g., income level may mediate opinions), financial health incentive intervention was generally accepted under certain conditions. Specifically, while initial disagreement existed within (e.g., ‘...*why should you be paid to do that...*’ vs. ‘...*I think there should be a role for incentives...*’) and between groups (e.g., Focus Groups #1 and #2 were initially split on the question of acceptability, while Focus Group #3 was entirely in favour under certain conditions), they all demonstrated an overall positive opinion regarding incentives once the range of common incentive program features were presented.

4.4.2 Ethical concerns

Four sub-themes emerged from the discussions that reflected common ethical considerations. A sub-theme common to each discussion had to do with the perceived ‘fairness’ of the intervention. In the broader context of the universal Canadian healthcare system, where tax payers pay into the healthcare system regardless of how much they use it, participants expressed their concern over public perception of incentive intervention: ‘...*can you imagine the hue and cry in society at large ...*’ Participants were generally uncomfortable with the idea of being perceived as ‘beneficiaries’ of an incentive program that was funded (in part) by their healthier, tax-paying counterparts. Similarly, the prospect of implementing incentives as an add-on to existing programming elicited a sense of ‘guilt’ among several patients, citing that people should not be paid to do the things they should be doing anyway.

The concern that the healthcare system and the Toronto Rehabilitation Institute in particular would bear the financial ‘burden’ of incentivizing CR graduates emerged as a sub-theme in each discussion. Explicit distaste for this hypothetical scenario was evident in all three focus groups and is illustrated here: ‘...*I would be upset if it came from the Government of Ontario...*’ Participants were generally concerned about whether an already financially strained healthcare system should be investing in a *new* program that distributed money to patients, particularly to patients who may not ‘need’, ‘want’ or

‘deserve’ the money/incentive. The final ‘Ethical issues’ sub-theme concerned the notion of incentives as ‘bribery’ and how cash incentives specifically might be perceived as a ‘bribe’. The majority of the speakers suggested that health-promoting, voucher-based incentives would be more acceptable than cash alone.

4.4.3 Incentive features moderating acceptability

Regardless of whether participants favoured incentive intervention at the outset of the focus group discussions or not, participants were more amenable to certain incentive features (outlined below). The majority of participants initially disagreeing with the incentive approach stated that they would enrol in an incentive program if the incentive was ‘meaningful’ (if incentives were of significant personal value e.g., voucher to *my* grocery store or to *my* gym), if the incentives were sufficient in size, and/or if the incentives were privately funded.

While the acceptability of cash-based incentives was split among participants, nearly all the participants expressed their preference for ‘meaningful’, health-promoting and voucher-based incentives, the first sub-theme in this category. For example, discounted access to community gym facilities to encourage sustained exercise after CR was identified by several participants as a ‘...*fantastic (idea)...*’ For others, however, gym membership reimbursements might not be as valuable: ‘...*I’d prefer to do my exercise outside...so there would be times that even if I had the incentive I wouldn’t use it...*’ In addition, educational resources, ‘coffee cards’, grocery vouchers, hospital parking passes, movie passes, and medical equipment were singled out, and generally perceived, as desirable voucher options. The participants overwhelmingly supported the idea of donating their incentives to charity as well, especially if they could receive a charitable donation tax receipt.

Participants generally believed that larger incentives would be more effective motivators. When presented with two distinct incentive magnitudes (i.e. \$2 vs. \$50 per week), participants responded by claiming \$2 per week ‘(is) *negligible*’. One participant felt that ‘...*if I can make a charitable donation with \$50 I’ll take the \$50...*’ Notably, for higher

income adults even large incentives may be inconsequential: *'...everyone has a dollar amount – to some people \$50 (per week) is still not enough'*.

Another sub-theme featuring prominently in all three groups (and linking to the 'Ethical concerns' theme) had to do with the 'source' of the incentive. The majority of participants agreed that they would prefer an incentive program that was privately sponsored: *'...as a person who looks at this ethically... I hope it would be non-government (sponsored)...'* A few participants qualified this sentiment by specifying that the source company should be perceived as an ethical one.

4.4.4 Effectiveness

Four sub-themes were similar enough in their relation to the question of effectiveness, an important acceptability moderator, that they were grouped together in one theme. Participants initially disagreeing with the incentive approach did so in part because they believed that the real incentive should be improved health and that the external motivation of financial incentives was not 'necessary'. Indeed, one participant claimed that she would only need to be asked to submit her exercise diary and she would comply. On the other hand, those who immediately favoured incentive intervention, about half of respondents, did so (in a few cases) by acknowledging how difficult it is to prioritize exercise. Competing priorities and low motivation, for instance, can make it very hard for individuals to exercise regularly they claimed. According to some of these respondents, novel strategies (such as incentives) that serve to overcome some of these barriers may be warranted.

Following this line of reasoning, participants generally believed that an incentive program would 'motivate' them/others to engage in exercise-related behaviours: *'...I'd be more inclined to do it (track my exercise) if someone paid me...'* While incentives that are modest in size may not be a primary motivator for many patients, one speaker thought that *'...\$10 won't change my life but it might you know I've done it twice would it encourage me to go a third time... ya it probably would...'* Several participants also believed that incentives may be particularly effective for lower SES adults because of the potential to 'lower economic barriers' (e.g., food or physical activity costs), a distinct

sub-theme illustrated herein: ‘...for people with limited means... absolutely money will be (motivating)...’ This statement is consistent with the literature which demonstrates that lower SES adults are generally more sensitive to incentive intervention (Kane et al. 2004); it also helps to illustrate the fourth ‘Effectiveness’ sub-theme which was that speakers generally believed that incentives may be effective for some (e.g., low SES adults or those with less intrinsic motivation to exercise), but not others.

4.5 Discussion

This focus group study shows that financial health incentives remain controversial. Many issues that are likely to be raised if financial health incentives were offered to Canadian CR patients were identified. For example, half of speakers initially disagreed with the incentive approach because they believed that it was unfair, unnecessary or a waste of limited resource. Notably, after focusing the discussion on more amenable incentive program features, the vast majority of speakers welcomed incentives under certain conditions, suggesting that initial concerns may be addressed with thoughtful incentive program design. For instance, health-promoting voucher-based incentives that could be donated and that are privately sponsored (not government funded) were deemed to be highly acceptable. Even seemingly subtle variations in incentive program design (e.g., offering cash instead of vouchers), it appears, can have a profound negative impact on acceptability.

This finding is consistent with the research in this area (Long et al. 2008; Promberger et al. 2012) that suggests that opinions may not be necessarily negative (as some earlier work may suggest), but rather are contingent on contextual factors. For instance, this study extends the findings of Priebe *et al.* (2011) and Promberger *et al.* (2012) who determined that acceptability is influenced by incentive type (e.g., cash vs. voucher) to a Canadian CR context. As with Priebe *et al.* (2011) and Promberger *et al.* (2012), voucher-based incentives were frequently favoured over cash incentives in the current sample of CR participants. In particular, voucher-based incentives sufficient in size (not ‘peanuts’) and that offset existing health-related expenses were perceived as more ‘meaningful’. Gym, transit, and food vouchers may be particularly salient for the study sample. One reason why these may be so amenable is because they may be viewed as part

of the solution (e.g., subsidizing prohibitively costly health-related expenses), rather than just as a reward as a ‘bribe’. In other words, it may be that health-related vouchers are perceived as serving the dual role of motivating regular exercise while reducing economic barriers to healthy behaviours (e.g., active transport via public transit, healthy diet) – the latter a potentially more noble feat than the former.

The option of paying incentives forward through charitable donations was viewed as highly acceptable as well. This option has several added benefits, including helping patients give back to their communities (increasing feelings of social-relatedness) and lowering the risk of antagonizing those who do not want to be rewarded at all (e.g., higher income adults, or the minority who fundamentally disagree with the approach in all cases). Nurturing feelings of social-relatedness and preserving individual autonomy may not only increase overall intervention acceptability, but it may also help individuals sustain their exercise over longer periods, and after incentives are withdrawn, as described previously (Mitchell and Faulkner 2012).

The ‘opportunity cost’ of incentive intervention is an important consideration and one that may be critical in the current Canadian context. Participants generally agreed that the financial burden of an incentive program should not be carried by ‘the health system’. Not only were participants concerned about the cost burden of incentive programming on the Canadian healthcare system, but they were cognizant of a potential public backlash to tax payer funded incentive programs. Others have noted the uncomfortable feelings associated with state-sponsored incentive programming as well (Priebe et al. 2010). These ‘uncomfortable feelings’, while likely the result of complex and intersecting factors (e.g., state of economy, SES/health status of individual, ethnicity and traditional values of the person), are noteworthy given that the aim of the intervention is to *reduce* the overwhelming financial burden of CVD. Future research may help to address this concern by demonstrating the potential cost-savings associated with an incentive intervention, especially compared to more traditional approaches. A novel approach that might further address this issue is the idea of partnering with private corporations to deliver incentives. There was consensus among participants that this would be a very

agreeable approach, so long as the source companies were deemed to be ethical in their business practices.

4.6 Limitations

While several studies have explored the ‘acceptability’ of incentives, the authors acknowledge as others have, that it is not a ‘normative concept that can be mapped directly onto right or wrong, fair or unfair’ (Promberger et al. 2011). ‘Acceptability’ does, however, serve to link the intervention, target behaviour, opinions and the wider context and in this sense is a useful, albeit limited, construct. Another weakness worth mentioning, and common to all focus group studies, is the possibility that the facilitator ‘promoted’ the use of incentives. While the research team took measures to protect against this (e.g., stated objective of learning about as many viewpoints as possible), the discussions may have been unduly influenced by the facilitator. Lastly, the rule of thumb is that research projects should consist of four to six focus groups (Morgan 1996). This study focused on one topic only and was standardized insofar as the questions posed were pre-specified which reduced the number of focus groups needed (by one) to explore opinions surrounding incentive intervention.

4.7 Conclusions

A key challenge in financial health incentive intervention is the identification of effective interventions *that are readily accepted* by the target population. The acceptability of financial health incentives is clearly shaped by contextual factors. This sample of Canadian CR participants were split on the idea of financial health incentives, but were in much stronger agreement when incentives were voucher-based, meaningful, large enough to motivate healthy behaviours, and not government funded. Our findings may be transferable to other CR settings with a similar demographic profile of participants. The results of this focus group study will inform the design of an incentive pilot trial examining physical activity maintenance at the Toronto Rehabilitation Institute and contribute to the broader debate regarding the role of incentives in government and corporate policy.

4.8 Acknowledgements

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Chapter 5

5 Development of the Health Incentive Program Questionnaire (HIP-Q) in a cardiac rehabilitation population

5.1 Abstract

Objective: To develop a questionnaire to facilitate the design of acceptable financial health incentive programs.

Methods: A multi-phase psychometric questionnaire development method was used. Theoretical and literature reviews, and three focus groups, generated a pool of content areas and items. New items were developed to ensure adequate content coverage.

Results: Field-testing was conducted with a convenience sample of cardiac rehabilitation (CR) patients (n=59) to establish face and construct validity ($p=0.021$), and reliability (intra-class coefficients=0.42-0.87). The final questionnaire is comprised of twenty-three items.

Conclusion: This questionnaire builds on previous attempts to explore acceptability by sampling a wider range of instrumental and affective attitudes, and by measuring the effect of program features on the likelihood of incentive program participation. Future research is now needed to examine whether tailoring incentives to preferences assessed by the questionnaire improves uptake and effectiveness.

5.2 Introduction

The societal costs of chronic disease are enormous. Employers bear their share of this burden as they pay more for unhealthy employees in health costs, disability and absenteeism expenses. In 2013, for example, US employers paid \$9,157 (US) per active employee in health costs – up from \$7,486 in 2009 (NBGH 2014). This number is expected to increase by 4.4% (twice the rate of inflation) in 2014. In response, many employers in the US (and elsewhere) have added wellness programs to their package of benefits. Low levels of employee engagement have unfortunately been a hallmark of these programs. Web-based wellness programs are particularly susceptible to attrition (Mitchell and Faulkner 2014). To boost engagement two-thirds of large US employers now offer financial incentives for wellness program participation (NBGH 2014). Companies are forging ahead with less than optimal incentive schemes, however, limiting returns-on-investment. For example, by offering incentives in the form of health insurance premium re-imbursements (61% of US employers do so) (NBGH 2014) for the attainment of hard-to-achieve biometric standards (58% of US employers do so) (NBGH 2014) companies risk squandering scarce resource on weak behavioural stimuli (Paul-Ebhohimhen and Avenell 2008; Volpp et al. 2011).

To optimize incentive program design, the range of incentive program features should be considered in the design process (see Table 5.1 for a list of incentive design features and attributes). To date, not enough attention has been paid to these features even though they appear to moderate effectiveness (Jeffery 2012). Even subtle variations in incentive design, for example, can have a profound impact on target group ‘acceptability’ (Priebe et al. 2010; Promberger et al. 2012), a critical pre-condition to successful incentive program implementation (Volpp et al. 2011). Since incentives for health remain a contentious topic (about half of survey respondents think they are unfair, coercive, a breach of privacy or a waste of limited resource) (Bonevski et al. 2011; Lynagh et al. 2011; Promberger et al. 2011; Bonevski et al. 2012; Park et al. 2012; Park et al. 2012; Blondon et al. 2014), a tool is needed to assess target group acceptability in advance of implementation. This tool could be used to identify acceptability moderators and preferred incentive features. Learning more about preferred incentive program features,

and how these vary for individuals and groups with shared characteristics (e.g., older employees, lower income earners), should inform the design of more refined, effective, cost-effective and marketable (e.g., ‘custom incentives’) incentive programs.

Therefore, the purpose of this study was to develop a new survey, called the Health Incentive Program Questionnaire (HIP-Q), to measure target group acceptability and identify preferred incentive program structures. Despite conducting this study with a convenience sample of cardiac rehabilitation (CR) patients, lessons learned from development of the HIP-Q may be applicable to employee directed incentives as well. Incentives that are more readily accepted by target groups may lead to greater program uptake, increase the potential for sustained behaviour change, and ultimately yield cost-effective outcomes.

Table 5.1 Financial health incentive design features and range of attributes for each

Features	Attributes
1. Form	(a) Cash (\$10 cash, cheque) (b) Voucher (iTunes, grocery, transit, Amazon) (c) Specific good/service (gym shoes, dietician consultation) (d) Reimbursement (existing expense reimbursed, like gym membership fee or health insurance premium) (e) Donation (value of incentive earned donated to charity of choice)
2. Magnitude	Continuous variable (often expressed as dollars (US) per week or month) ^a
3. Target	(a) Self-regulatory behaviour (self-monitoring, scheduling, seeking social support) (b) Behavior (exercise, medication adherence) (b) Outcome (BMI < 25 kg/m ² , BP < 140/90)
4. Timing of assessment	(a) Completion of incentive program (6 months) (b) Set intervals (daily/weekly assessments) (c) Random intervals (10 assessments over 6 months) (d) Dependent intervals (varying intervals based on previous performance)
5. Type of assessment	(a) Self-report (exercise diary submission)

	(b) Objective, direct assessment (face-to-face) (c) Objective, indirect assessment (pedometer, photo of weight on scale)
6. Reward immediacy ^b	Continuous variable (often expressed as days or weeks between assessment and reward)
7. Certainty	(a) Certain (\$50 for meeting A1C target) (b) Certain chance (1 in 4 chance of \$25) (c) Uncertain chance (1 in 100 change of \$500) (d) Mix (\$50 and a 1 in 100 chance of \$500)
8. Schedule	(a) Uniform (\$50 lump sum for meeting goal) (b) Indexed (\$1 for each gym visit) (c) Escalating (\$1 for first 10 gym visits, \$2 for next 10, etc.) (d) Random (\$1 to \$50 for gym visits)
9. Dispensing type	(a) Resetting (discreet reward at time of each achievement) (b) Aggregative (“passbook saving” – information on running tally given) (c) Mix (accumulated incentives lost if discreet goal not met, “Go back to zero if missed gym visit.”)
10. Participant investment	(a) Opportunity cost only (time) (b) Deposit contract (own money lost if fail to achieve goal) (c) Matching (‘double or nothing’) (\$50 of own money lost if fail, \$50 extra gained if successful)
11. Information disclosure	(a) Factual (information given about meeting or failing to meet goal) (b) Counterfactual (information given about reward lost by failing to meet goal i.e. regret)
12. Duration	Continuous variable (often expressed in weeks or months incentive available; maybe indefinitely)
13. Source	(a) Self or significant others (spouse, friend) (b) Group members (incentive plan members) (c) Government (d) Employer (e) Insurance company (f) Other (non-insurance) companies
14. Recipient	(a) Individual (cash for weight lost) (b) Group (reward for > 50% group attendance) (c) Significant other(s) (spouse, parent) (d) Charitable organization

NOTE. This table represents a combination of works published by Klein & Karlawish (2010), Adams *et al.* (2013) and Mitchell *et al.* (2013). Bolded items have not been previously published.

^aMagnitude is ideally considered in relation to individual/group socio-economic circumstance.

^bConsider when (1) behaviour/outcome assessed, (2) when it is rewarded, and (3) the time between assessment and reward.

5.3 Methods

A multi-phase psychometric questionnaire development method was used to develop the HIP-Q (Streiner and Norman 2008). The HIP-Q is designed specifically to optimize incentives *for exercise*, since the authors of this study planned to deploy the questionnaire for the first time in a CR context, where exercise is the cornerstone therapy. Of all the chronic disease risk factors, physical inactivity is arguably the most important (Lee et al. 2012), and has been recently shown to increase healthcare costs in U.S. employees with metabolic syndrome by about 30% (Burton et al. 2014). Incentives can target any number of health behaviors though (e.g., medication adherence, weight loss) and the HIP-Q was designed to easily incorporate them (e.g., by replacing the word “exercise” with “take my medications” or “lose weight” in HIP-Q item #1 stem: “*For me, getting paid cash or healthy vouchers to exercise/take my medications/lose weight **would be...***” A convenience sample of English-speaking CR participants was recruited from the Toronto Rehabilitation Institute’s (Toronto Rehab) to participate in the development of the HIP-Q. Participants were recruited between February and October 2013 by a researcher at the beginning of their weekly CR sessions. The sample broadly reflected the socio-demographic profile (e.g., gender, marital status, income) of cardiac patients in Ontario (see Table 5.2 for population and sample characteristics). Drawing from the Toronto Rehab CR population was deemed appropriate since it is suggested high-risk, high-cost groups, such as older adults living with cardiovascular disease, should be the initial targets of incentive interventions (Ades and Gaalema 2012; Loewenstein et al. 2013). The research ethics boards of the University Health Network and the University of Toronto approved this study. The development of the questionnaire consisted of five phases.

Table 5.2. Population and sample socio-demographic characteristics.

	Population^a n=1807	Sample n=59
Age (years, mean ± SD)	65.4 ± 10.4	66.0 ± 10.9
Female	450 (25)	13 (22)
Caucasian	1446 (83)	47 (80)
Married	1392 (78)	37 (63)
Retired	905 (52)	36 (61)
Post-secondary education	1312 (75)	43 (73)
Household Income (Canadian dollars)		
< \$35,000	N/A	12 (20)
< \$65,000	N/A	27 (46)
> \$65,000	730 (50) ^b	32 (54)
> \$95,000	N/A	22 (37)

NOTE. Numbers in parentheses represent the percent of participants within the condition (column) possessing the given attribute.

^a Socio-demographic characteristics of cardiac inpatients from 11 Ontario hospitals enrolled in the Cardiac Rehabilitation care Continuity through Automatic Referral Evaluation study (1807 out of 2635 recruited patients were enrolled) (Shanmugasagaram et al. 2013).

^b Annual family income > \$50,000 Canadian.

PHASE 1: Identifying content areas and items

Step 1 – Literature review

A review of relevant behavior change theories served a “heuristic purpose” (Streiner and Norman 2008) suggesting content areas that the authors could use to begin to shape the HIP-Q as well as to identify and/or phrase items. A systematic review of the literature examining incentives for exercise adherence in adults (Mitchell et al. 2013), and an overview of related papers and reviews, also added to the inventory of content areas and items.

Step 2 – Focus groups

Three focus groups of five to six CR participants were conducted to explore opinions of incentives, and elucidate content areas and items that may not have emerged from the theoretic/literature reviews. The focus group methodologies have been previously reported (Mitchell et al. 2014).

PHASE 2: New item generation

Step 3 – Drafting new items

New items were developed to ensure adequate coverage in the HIP-Q. The fourteen features of incentive programs in Table 5.1 were used to guide this step, ensuring all features (and attributes) were considered in the incentive design process.

PHASE 3: Content validity

Step 4 – Expert consultation

Once new items were written, a draft of the HIP-Q and an accompanying review guide were sent to five international experts with experience conducting incentive research, writing about incentives, implementing incentives, developing surveys and/or working with CR patients. Four out of five experts held Ph.D. degrees in health behavior change or related fields. In the review guide experts were asked about the appropriateness and clarity of items using a 4-point Likert scale. Items with mean scores below three were discarded or re-considered. Experts were also asked if the HIP-Q sampled all relevant content given its stated purpose, and to recommend additional content areas/items, if needed. Lastly, experts were asked to recommend different approaches to scaling, and to re-word items, as required.

PHASE 4: Face validity

Step 5 – Pre-testing

The HIP-Q was pre-tested in one-on-one interviews to ensure that it was comprehensible for the target population before pilot testing it with a larger group. To explore whether the questions were clear, individuals were asked to ‘think aloud’ through their responses to

identify problem items. Problem items were re-written or eliminated. Frequency of endorsement was tested and discarding item alternatives was considered if endorsed by very few or very many (endorsement rate of 0.20 and 0.80, respectively). Pre-testing continued until no new concerns arose. Time for HIP-Q completion was recorded.

PHASE 5: Construct Validity and Reliability

Step 6 – Pilot testing

The final draft of the HIP-Q (23 total items) was piloted through paper-and-pencil self-administration in a convenience sample of 59 CR patients to test construct validity and reliability. In line with self-determination theory, the authors hypothesized that individuals scoring lower on the Relative Autonomy Index (RAI; summary measure of intrinsic motivation to exercise calculated using the Behavioral Regulation to Exercise Questionnaire (BREQ-3)) (Wilson et al. 2006), would favor incentive program participation, as indicated by a ‘likely’ or ‘very likely’ response to HIP-Q item #2: *“In general, how likely would you be to participate in an incentive program that paid you \$40 a month for exercising 15 minutes a day, 3 days a week?”*

Statistical analyses

The magnitude and statistical significance of the relationship between the RAI and the ‘likelihood of participation’ response was evaluated using Pearson’s correlation coefficient. To test reliability, a seven-day test-retest was conducted and intra-class coefficients (ICC) were computed. Identifying the number of patients leaving more than 10% of items unanswered also tested completeness of item responses, or who incorrectly answered items. All data analyses were conducted using the Statistical Package for the Social Sciences 22.0 (SPSS).

5.4 Results

PHASE 1: Identifying content areas and items

Step 1 – Literature review

The theoretical review conducted during Phase 1 highlighted the value of grounding incentives in health behavior change theory. A full outline of the theoretical considerations informing the development of the HIP-Q are reported elsewhere (Mitchell and Faulkner 2012). In keeping with self-determination theory in particular, for incentives to drive sustained health behavior change, the authors suggest incentives be designed in a way that fulfills the basic psychological needs of competence (experiencing mastery), autonomy (a sense of ownership over behavior) and/or social relatedness (feeling socially connected to others). The HIP-Q therefore included items that aimed to identify health behaviors or outcomes that prospective participants could realistically achieve (to increase confidence). The HIP-Q's purpose was to aid in the delivery of custom incentives to increase feelings of ownership and autonomy. Last, incentives related to social outcomes (e.g., charitable donations), or that promote social interaction (e.g., incentives for group success) were included in the HIP-Q as plausible program options. The three psychological needs described in self-determination theory were carefully considered, therefore, in the development of the HIP-Q.

The literature review undertaken by the authors (Mitchell et al. 2013) uncovered two papers that outlined and defined the set of incentive design features (and their associated attributes) (Klein and Karlawish 2010; Adams et al. 2013). So not to neglect important features in the design process, the HIP-Q was formatted according to these published features (there are 11 in total), as well as three additional features emerging from the authors' review (Mitchell et al. 2013) (i.e. type of assessment, duration of incentive program, source of incentive; see Table 5.1), with the aim of using the data to customize incentive programs. According to a 2013 Consensus Statement, *Guidance for a Reasonably Designed, Employer-Sponsored Wellness Program Using Outcomes Based Incentives*, to build employee acceptance all "reasonably designed" incentive programs should consider the full range of incentive approaches when looking to increase wellness program uptake and engagement (Consensus Statement of the Health Enhancement Research et al. 2012). In addition, a questionnaire developed and used by Long *et al.* (2008) to examine opinions of incentives was discovered during the literature review phase of this study (Long et al. 2008). This questionnaire was not validated but provided a foundation from which to build an updated, more comprehensive, and psychometrically

sound incentive-focused questionnaire. The questions developed by Long *et al.* (2008) were used as the initial basis for the HIP-Q items.

Step 2 – Focus groups

The focus group results have been previously reported (Mitchell et al. 2014). Briefly, a thematic analysis of the focus group data revealed that participants' ethical concerns with incentives were prominent, but were mitigated in considering a range of program features, including source (e.g., government vs. private company), and type (e.g., cash vs. voucher) of incentive, as well as incentive target (e.g., behavior vs. outcome) (see Figure 4.2 for an overview of focus group themes and acceptability moderators). Identifying the features most likely to elicit strong (negative) reactions in this sample focused the authors' attention on key content areas (i.e. design features), ensuring that these areas/features were adequately addressed in the questionnaire.

PHASE 2: New item generation

Step 3 – Drafting new items

Since ethical concerns were prominent in the focus groups (consistent with the literature) (Priebe et al. 2010; Bonevski et al. 2011; Lynagh et al. 2011; Promberger et al. 2011; Bonevski et al. 2012; Park et al. 2012; Park et al. 2012; Promberger et al. 2012), the Long *et al.* (2008) questionnaire was expanded using Spector's (1976) and Ajzen's (2002) lists of categories to include seven total pairs of instrumental (e.g., Necessary/Unnecessary) and affective (e.g., Fun/Not Fun) attitudes. A paired-comparison technique was used here, where respondents were asked to indicate which attitudinal opposite they agreed with most on a 7-point Likert scale (uneven to offer a 'neutral position', and with most points labeled to ease cognitive requirements).

A paired-comparison technique using 7-point Likert scales was also used to identify features that may increase the 'likelihood' of incentive program participation as well as to identify preferred incentive design features. The 'likelihood of participation' and incentive design preference items were deemed to be more directly relevant for employers and others interested in investing in incentives for health than broader

attitudinal items. Notably, it was not suitable for every incentive design feature from Table 5.1 to be represented in the HIP-Q. In particular, new items exploring features #4, #8 and #9 (timing of assessment, schedule and dispensing type) were not drafted given the overlap with feature #6 (reward immediacy). To further limit redundancy, feature #5 (type of assessment, e.g., self-report) was not explicitly represented in the HIP-Q either given similarities with feature #3 (incentive target, e.g., self-monitoring).

One categorical item was drafted to identify specific voucher preferences, since vouchers may be perceived as more acceptable and meaningful than cash alone (Mitchell et al. 2014). In total, twenty-eight new items were drafted (replacing the Long *et al.* items) to accommodate a more comprehensive assessment of attitudes around incentives and to determine whether acceptability varies with design features/attributes. Several steps were taken to ensure the newly devised items were psychometrically sound including using words that do not require greater than a 6th grade reading level.

PHASE 3: Content validity

Step 4 – Expert consultation

Mean appropriateness and clarity scores, as given by content experts, ranged from 3.2 to 4.0 and thus no items were discarded due to low scores. Seven items were edited, as per reviewer suggestions, to increase clarity. To ease cognitive requirements the number of response alternatives for the paired-comparisons was reduced to five (from seven). The instructions and stems in this section were also edited for clarity. The depth to which certain items explored the role of design feature attributes in moderating acceptability (e.g., certain vs. uncertain rewards) was deemed to be unnecessarily complex, and potentially confusing, by three experts, and so these items were re-written. Once recommendations from experts were incorporated a ‘readability score’ (7.6 Fleisch-Kincaid Grade Level) was generated using Microsoft Word. This score was interpreted with caution given some of the limitations outlined by Streiner & Norman (2008).

PHASE 4: Face validity

Step 5 – Pre-testing

Eight participants completed the HIP-Q and participated in one-on-one interviews. No new concerns arose during the final three interviews and so sampling ceased at this point. Missing values on one or more items occurred in three participants (37.5%). Paired-comparison items (for instrumental and affective attitudes) were re-formatted to include *labeled check boxes* (see Figure 5.1, or the full HIP-Q in Appendix F), rather than numbers (1-5) to be circled, as the inherent values of numbers confused some of the participants (e.g., “So ‘1’ is the highest?”).

1. For each pair of words below, check the box that best represents how you feel about being paid to exercise.

“For me, getting paid cash or healthy vouchers to exercise would be...”

<u>Effective</u>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<u>Not effective</u>
	Strongly Agree	Agree	Neutral	Agree	Strongly Agree	

2. In general, how likely would you be to participate in an incentive program that paid you \$40 a month for exercising 15 minutes a day, 3 days a week? Please circle one (1) option.

Very unlikely	Unlikely	Neutral	Likely	Very likely
1	2	3	4	5

3. “I would be more likely to participate in an incentive program if I was...” Please check one (1) of the boxes.

- Paid cash
- Paid with vouchers, like grocery store or gym membership vouchers
- Able to donate my incentive to my favourite charity
- The ‘type’ of incentive doesn’t matter to me
- I would NOT participate in an incentive program

If you were being paid to exercise for 15 minutes a day, 3 days a week, for a month, which incentive program ‘feature’ below would you prefer?

4. The ‘guaranteed’ or the ‘lottery’ incentive feature? Please check one (1) of the boxes.

- Get paid \$40 for sure – ‘guaranteed’ incentive
- Have a 1 in 10 chance of winning \$300 – ‘lottery’ incentive
- I don’t have a preference
- I would NOT participate in an incentive program

Figure 5.1. Sample Health Incentive Program Questionnaire (HIP-Q) items.

Using paired-comparisons to examine the impact of *subtle* feature attribute variations on opinions confused some participants (see Figure 5.2). For this reason, questions about feature attribute preferences were re-formatted to simpler categorical judgments (see Figure 5.1, item 4), with fewer ‘variations’ presented, bringing the total number of HIP-Q items to 23, from 28. Endorsement rates of item alternatives did not fall outside *a priori* parameters and so no item alternatives were eliminated. The average time to completion was 13 minutes 21 seconds.

1. For each **pair of words** use the scale to indicate which one best represents how you would complete the sentences below.

If I were participating in a **weekly** incentive program (reward paid out each week), I would prefer...

	Strongly prefer		Don't care		Strongly prefer	
\$10 for sure	1	2	3	4	5	1 in 4 chance (25%) for \$40
\$10 for sure	1	2	3	4	5	1 in 4 chance (25%) for <u>\$35</u>
\$10 for sure	1	2	3	4	5	1 in 10 chance (10%) for \$100
\$10 for sure	1	2	3	4	5	1 in 10 chance (10%) for <u>\$90</u>

Figure 5.2. Item from the ‘pre-testing’ draft of the Health Incentive Program Questionnaire (HIP-Q) using paired-comparisons to examine the impact of subtle feature attribute variations on incentive program preferences.

PHASE 5: Construct validity and reliability

Step 6 – Pilot testing

The HIP-Q was pilot tested with CR patients through self-administration to test construct validity (n=59) and reliability (n=32). Seventy-one percent (17/24) of respondents with RAIs below the group mean (i.e. more externally controlled – “I exercise because my doctor told me to.”) indicated that they would be likely/very likely to participate in an incentive program compared to 51% (18/35) of those above the mean (e.g., “I exercise because I enjoy it.”). As well, RAI and likelihood of participation were correlated ($p=0.021$) supporting the authors’ *a priori* hypothesis that less self-determined respondents would self-report being more likely to participate in an incentive intervention. An examination of BREQ-3 sub-scales yielded similar results, with 71% of more ‘externally regulated’ respondents (15/21, vs. 52% of those less ‘externally regulated’) indicating they would be likely/very likely to participate in an incentive program. Ten (16.9%) respondents either did not answer, or incorrectly answered, 10% or more of the items. For instrumental and affective attitude items the ICCs were 0.76 and 0.60, respectively. For categorical items, the ICCs ranged from 0.42 to 0.87 (see Figure 5.1 for a sample of HIP-Q items and Appendix F for the full questionnaire).

5.5 Discussion

The aim of this study was to develop a valid and reliable questionnaire for the purpose of customizing health incentives. This is the latest attempt to develop a novel incentive design tool, the first study to consider the broad range of incentive design features in the development of such a tool, and the first to psychometrically evaluate a health incentives program questionnaire. Although this study was conducted in a CR context, there is no obvious reason the HIP-Q cannot be applied in other contexts and for other health behaviors given its focus on core design features of incentives. Preferences may certainly vary across populations and contexts and further validation work will be needed to demonstrate this.

Psychometric properties

The HIP-Q demonstrated content, face and construct validity. Informed by the extant literature and expert review, the HIP-Q adequately covers the relevant information. As well, items were interpretable by the target population during pre-testing, and pilot testing demonstrated that the HIP-Q (item #2) is significantly related to RAI (calculated using the BREQ-3) (Wilson et al. 2006), consistent with self-determination theory, increasing confidence in responses. HIP-Q test-retest reliability was partly supported as well, with 12 out of 23 items demonstrating ‘Good’ reliability ($ICC \geq 0.7$). Since the purpose of the HIP-Q was to assess as many design features as possible, items with less than satisfactory reliability ($n=11$; $ICC < 0.7$) were not discarded. Those interested in implementing incentives should interpret item responses with caution until further validation is conducted. Notably, affective attitude items (e.g., Good vs. Bad) yielded different responses over time ($ICC=0.60$). Affective attitudes around incentives may be nebulous, changing over time, perhaps with the presentation of new information, or in different settings, or with more time for personal reflection on a contentious topic. Before drawing firm conclusions regarding the reliability of these items, further study is warranted with a larger sample.

Application

The HIP-Q is a comprehensive incentive design tool that has several potential applications. Since low program uptake is a barrier to successful implementation, the HIP-Q may be used to identify the overall acceptability of interventions. Although effectiveness was not tested in this article, the authors presume that higher acceptance of incentive designs may lead to greater effectiveness, as has been suggested (Volpp et al. 2011). Not only may the HIP-Q be used to identify perceived levels of effectiveness and acceptability (instrumental and affective attitudes), but it may also be used to establish how likely individual would be to sign-up for an incentive program. The HIP-Q allows for the identification of feature attributes that may boost likelihood of participation as well, providing incentive program sponsors with information to customize incentive

packages so they are more readily accepted by target groups. Building a repository of incentive program design preferences over time, and linking these to socio-demographic, health status, and health behavior characteristics, may help segment incentive interventions in the future.

The HIP-Q may also help to shed light on the question of ‘incentive direction’ (i.e. Should companies implement financial health incentives, or penalties?). For instance, HIP-Q items #6 and 7 ask respondents how likely they would be to ‘wager’ their own money in an incentive program (called a ‘deposit contract’). The answers to these questions may give companies a sense of how receptive employees would be to financial *dis*-incentives – an important consideration since employers are increasingly turning to penalty-based systems (NBGH 2014). Our position is that penalties are more likely to generate resistance (Volpp and Galvin 2014) and undermine intrinsic motivation (Mitchell and Faulkner 2012), limit enrolment (Volpp and Galvin 2014), and discriminate disadvantaged groups (Madison et al. 2013).

Regarding tailored incentive programs, a growing body of research is examining how individual characteristics (e.g., age, income, confidence to exercise, weight status, consumer habits/preferences) moderate incentive effectiveness, and how these characteristics interact with incentive design features/attributes to produce health behavior change. For instance, John et al. (2012) determined in a sample of low and high income adults that the higher income individuals were more sensitive to lottery-based (vs. certain) and voucher-type (vs. cash) incentives compared to their lower income counterparts (John et al. 2012). As this body of research develops, interventionists will be in a better position to match individual characteristics to preferred and/or more effective incentive design features/attributes.

For instance, in the future, older adults may be offered ‘certain chance’ incentives (e.g., 1 in 5 chance of winning \$25) given their suspected inclination toward lottery-based interventions (Klein and Karlawish 2010); higher income individuals may receive larger incentives (1.2% or more of disposable income, as has been suggested) (Paul-Ebhohimhen and Avenell 2008); individuals identified as less confident in their ability to

exercise may be offered incentives for more achievable, ‘self-regulatory’ behaviors (e.g., wearing a pedometer) as opposed to the attainment of difficult to achieve outcomes (e.g., lose 10 pounds) (Mitchell and Faulkner 2012); overweight adults could receive escalating incentives to drive regular exercise over longer periods (Jeffery et al. 1998); individuals preferring grocery store over iTunes vouchers may receive the credit they prefer and value the most (Hunter et al. 2013). Collecting relevant socio-demographic and health-related information in future studies will assist with the matching of personal characteristics with more promising incentive approaches.

Study limitations

The HIP-Q builds on previous attempts to explore incentive acceptability by sampling a wider range of instrumental and affective attitudes and by measuring the effect of program features, including type, source, timing, and certainty of incentive, on the likelihood of incentive program participation. It was not suitable to have all fourteen features from Table 5.1 represented in the HIP-Q, however. Asking prospective participants about all possible incentive design subtleties proved challenging, in part because it was difficult to fully explore feature nuances in a succinct questionnaire and phrase items in a way that was comprehensible to the target group. Rather, the HIP-Q ended up focusing on those features most likely to moderate opinions in a Canadian CR population (Mitchell et al. 2014) and increase probability of incentive program participation.

Owing to the complexity of some of the items the final iterations of the HIP-Q were simplified (using more general categorical judgements) to maintain the psychometric qualities of the questionnaire. Several questions exploring the subtleties of incentive program design were omitted on account of their perceived complexity, leaving several features only superficially explored (#1-3, 6-7, 10, 12-13). Nonetheless, this questionnaire is the first to the authors’ knowledge to examine the impact of multiple incentive program features on acceptability, and in this sense makes a novel contribution to wellness incentive programming and research/evaluation.

The following limitations should also be noted. Regarding low test-retest reliability during the pilot testing phase of this study, HIP-Q items were completed *following* the completion of several related questionnaires (demographic and health-related surveys) and thus responder fatigue may partially account for this. For the affective attitude items, the authors suggest reliability was low because opinions actually shifted over time, rather than CR patients not fully comprehending the questions, since similarly phrased instrumental attitude items demonstrated ‘Good’ reliability. More research examining affective attitudes is needed. The study sample of CR patients was a convenience sample and thus the generalizability of the psychometric properties of the HIP-Q is limited. Certainly, as incentives grow in popularity, it will be worth testing the questionnaire among people in different settings (e.g., younger employees in different sectors), especially within the context of workplace wellness programs targeting multiple health behaviours.

Though several steps were taken to ensure HIP-Q items were psychometrically sound, they are not without limitation. For example, the stem for item #1 includes both “cash” and “healthy vouchers” which may be problematic for two reasons. First, cash and vouchers may not be equally acceptable due to (a) dead weight loss of the voucher if it is for an item the recipient does not value as much as the giver, and (b) time discounting associated with future use of the voucher vs. immediate value of cash. Second, the use of the positive word "healthy" before voucher is not balanced by a similarly positive word before cash. Although these issues cannot be fixed *post hoc*, they should be acknowledged as limitations. Future validation studies will aim to optimize the psychometrics of the HIP-Q and maximize its’ generalizability.

5.6 Conclusions

Financial health incentive programs should be carefully designed, considering the range of available features and attributes in the design process, as well as the impact of contextual factors on incentive acceptability and effectiveness. Even subtle variations in incentive program design can have profound effects. The newly developed HIP-Q has the potential to be a useful tool for assessing attitudes of incentives and examining the role of

design features in moderating acceptability and uptake. Taken together, the HIP-Q may serve as a practical incentive design tool, used to increase financial health incentive program acceptability and uptake. Further research is now needed to examine whether tailoring incentives to preferences assessed by the HIP-Q improves uptake and effectiveness.

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Chapter 6

6 A feasibility study of financial incentives to increase exercise among Canadian cardiac rehabilitation patients

6.1 Abstract

Purpose: To examine the feasibility of conducting a randomized controlled trial investigating the effectiveness of financial incentives for exercise self-monitoring in cardiac rehabilitation (CR).

Methods: A 12-week, two parallel-arm, single-blind feasibility study design was employed. A volunteer sample of CR program graduates was randomly assigned to an exercise self-monitoring intervention only (control; n=14; mean age±SD, 62.7±14.6y), or an exercise self-monitoring plus incentives approach (incentive; n=13; mean age±SD, 63.6±11.8y). Control group participants received a ‘home-based’ exercise self-monitoring program following CR program completion (exercise diaries could be submitted online or by post). Incentive group participants received the ‘home-based’ program, plus voucher-based incentives for exercise diary submissions (\$2/day). A range of feasibility outcomes is presented, including recruitment and retention rates, and intervention acceptability. Data for the proposed primary outcome of a definitive trial, aerobic fitness, are also reported.

Results: Seventy-four CR graduates were potentially eligible to participate, 27 were enrolled (36.5% recruitment rate; twice the expected rate), and five were lost to follow-up (80% retention). Intervention acceptability was high with three-quarters of participants indicating they would likely sign-up for an incentive program at baseline. While group differences in exercise self-monitoring (the incentive ‘target’) were not observed, modest (statistically non-significant) changes in aerobic fitness were noted with fitness increasing by 0.23 ml/kg/min among incentive participants, and decreasing by 0.68 ml/kg/min among controls.

Conclusion: This preliminary study demonstrates the feasibility of studying incentives in a CR context, and the potential for incentives to be readily accepted in the broader context of the Canadian healthcare system.

6.2 Introduction

A growing body of scientific evidence, now including several systematic reviews of randomized trials, has shown that financial health incentives may assist with health behavior changes, such as increasing regular exercise (Mitchell et al. 2013; Strohacker et al. 2014). Since incentives offer a potentially effective and scalable method for promoting healthy behaviors, they have been widely implemented by governments and corporations to improve health outcomes. Only recently have incentives emerged as a policy alternative in Canada. Notably, in 2013 the Public Health Agency of Canada funded a \$750,000 pilot project to reward YMCA members with AIR MILES Reward Miles™ to attend the gym (PHAC 2013).

The cost-effectiveness of incentive interventions may be greatest when targeting preventive health behaviors in clinical populations. Though they have been tested in clinical settings in the past (DeFulio and Silverman 2012), to the authors' knowledge, patient-targeted incentives have not been evaluated in the context of Canadian healthcare, where their acceptability and effectiveness may be different than in the U.S. – the origin of the majority of the incentive research. Indeed, previous research has shown incentive acceptability (Promberger et al. 2012) and effectiveness (John et al. 2012) to be inextricably linked with contextual factors such as health status and country of origin.

Cardiac rehabilitation (CR) is a suitable initial target for incentive intervention since many cardiovascular disease risk factors are under behavioral control. Pack *et al.* (2013) were the first to evaluate incentives in CR by examining the impact of 'token' incentives (e.g., t-shirts, parking passes) on program attendance (Pack et al. 2013). Though the Pack et al. (2013) study boasts several strengths, the authors did not randomize study participants, nor were they able to isolate the impact of incentives from other intervention components. For this reason, a definitive randomized trial testing the efficacy of incentives in CR is warranted.

To set the stage for a definitive RCT we conducted this feasibility trial. The purpose of this preliminary study was to pilot new methodological procedures, and examine how study components work together. Since up to 75% of CR graduates discontinue regular exercise following program completion (Zullo et al. 2010), incentives were used to support the difficult transition for graduates to *unsupervised, community-based* exercise. Specifically, incentives were used to encourage exercise self-monitoring.

6.3 Methods

This was a 12-week, two arm, single-blind feasibility study and was approved by the research ethics boards of the University Health Network and the University of Toronto. We attempted to recruit all Toronto Rehabilitation Institute (Toronto Rehab) CR patients graduating in September and October 2013 (n=74) to ensure a sample size of at least 12 per group, as recommended for feasibility studies (Julious 2005). Prospective enrollees were informed that they would receive \$50 in vouchers for study assessments (baseline, follow-up). Exclusion criteria were limited to conditions making participation infeasible (e.g., non-English speaking). Following written informed consent, eligible participants received randomly assigned study packages containing group-specific instructions. Packages were randomized evenly using www.random.org.

Intervention

Control group

A new ‘home-based’ exercise self-monitoring program was offered. Participants were asked to continue submitting weekly exercise diaries (recording type of exercise, time spent exercising), for 12 weeks, by regular post or using a specially-designed website. Participants choosing to submit diary information online were instructed to do so daily, but had until the end of the week (Sunday midnight) to complete their diary. All participants received basic feedback following diary submission (e.g., “*You completed 60% of your prescribed exercise sessions this week [4 out of 7]*”).

Incentive group

Participants in the incentive group received the ‘home-based’ exercise self-monitoring intervention, plus voucher-based incentives. The incentive contingency was the only feature distinguishing the groups. Incentive group participants earned \$2/day for completing their diary. This magnitude of incentive has been previously recommended (see Appendix G for a detailed description of the incentive scheme) (Paul-Ebhohimhen and Avenell 2008). Upon satisfying the incentive contingency, participants could redeem their reward each week from a list of desirable voucher options, including grocery store vouchers and donations to Toronto Rehab. The action of self-monitoring was incentivized - rather than exercise *per se*, or an exercise-related outcome like aerobic fitness - since incentives for *self-regulatory* behaviors (e.g., self-monitoring) are less likely to “crowd out” intrinsic motivation, an often-cited risk of incentive intervention (Promberger and Marteau 2013).

Outcomes

The primary outcomes of this study focus on feasibility as measured by recruitment rate, randomization procedures, adherence with exercise self-monitoring, incentive provision, and retention rate. Intervention acceptability and program satisfaction were also assessed by questionnaire. Change in aerobic fitness (measured by symptom-limited graded exercise testing at Study Weeks 0 and 12 by blinded assessors), the proposed primary outcome of a definitive trial, was calculated. As well, exercise self-efficacy and self-determined motivation are proposed secondary outcomes of a definitive trial since they predict exercise maintenance in this population (Woodgate et al. 2005).

Statistical analyses

To investigate whether the randomization procedure was effective, baseline characteristics were checked for normality and examined by study arm using independent samples Student’s t-tests and Fisher’s Exact tests. Adherence with exercise self-monitoring is expressed as proportion of participants submitting exercise diary information on at least nine out of the 12 weeks (75% of the time; threshold above which

significant health benefits may accrue) (Alter et al. 2014), as well as number of days self-monitored. Retention rate was calculated by dividing the number of participants completing the Study Week 12 assessment with the number of participants initially enrolled. Acceptability is reported as the proportion of participants indicating that they would be likely/very likely to sign-up for an incentive program, as well as the mean likelihood (5-point Likert scale) of incentive program participation at baseline and follow-up. Exit survey data is summarized using proportions. Factorial repeated measures ANOVA was used to explore the relationship between group assignment and change in aerobic fitness. Group means for exercise self-efficacy and self-determined motivation are presented as well.

6.4 Results

Study sample

Seventy-four CR graduates were potentially eligible to participate in the study and all of them were approached. Twenty-seven agreed to be enrolled (36.5% recruitment rate). The volunteer sample broadly reflected the socio-demographic profile of CR patients in Ontario (Table 6.1). Baseline characteristics of control and incentive participants were similar, with the exception of household income ($p=0.021$), a potential confounder. Fewer than 20% of participants were lost to follow-up (control=3/14, incentive=2/13; lack of interest=4, injury=1).

Table 6.1. Population^a and sample (by study arm) characteristics.

	Population^a n=944	Incentive n=13	Control n=14
Age (years)	64.1 ± 9.8	63.6 ± 11.8	62.7 ± 14.6
Female	205(21.7)	2 (15.4)	4 (28.6)
Caucasian	761 (83.6)	10 (76.9)	10 (71.4)
Married	775 (82.8)	9 (69.2)	10 (71.4)
Retired	438 (48.1)	7 (53.8)	7 (50.0)
Post-secondary education	744 (81.1)	9 (69.2)	8 (57.1)
Household Income (Canadian dollars)			
< \$35,000	N/A	1 (7.7)	1 (7.1)
< \$65,000	N/A	3 (23.1)	6 (42.9)
> \$65,000	456 (60.0) ^b	10 (76.9)	8 (57.1)
> \$95,000	N/A	9 (69.3)*	3 (21.4)*
Daily internet use	N/A	10 (76.9)	9 (64.2)
Body Mass Index (kg/m ²)	29.0 ± 5.1	28.2 ± 7.4	31.6 ± 6.7
Smoking	45 (5.0)	0 (0)	1 (7)
VO _{2peak} (ml/kg/min)	N/A	26.5 ± 9.4	24.9 ± 10.6
RAI	N/A	46.6 ± 22.8	45.2 ± 20.3
Self-efficacy (barrier, scheduling)	N/A	5.5 ± 3.2 9.1 ± 0.9	5.8 ± 2.6 8.4 ± 1.7

NOTE. Data are presented as means ± SD. Numbers in parentheses represent the percent of participants within the condition (column) possessing the given attribute. *Significant difference between study arms (p<0.05).

^a Socio-demographic characteristics of cardiac inpatients from 11 Ontario hospitals enrolled in the Cardiac Rehabilitation care Continuity through Automatic Referral Evaluation study (1807 out of 2635 recruited patients were enrolled, 944 patients have participated in CR) (Shanmugasagaram et al. 2013).

^b Annual family income > \$50,000 Canadian

Abbreviations: RAI, Relative Autonomy Index; VO_{2peak}, volume of oxygen consumed at peak of exercise.

Adherence with exercise self-monitoring

The proportion of participants submitting exercise diaries 75% of the time did not differ by study arm (control=11/13 vs. incentive=11/14). Similarly, both control and incentive group participants self-monitored exercise an average of 4.5 exercise sessions per week.

Incentive acceptability and provision

In total, 55% of participants indicated they would be likely/very likely to sign-up for a hypothetical incentive program. This proportion increased to 74% if participants were given the option of donating incentives to charity. The likelihood of incentive program participation remained stable for control group participants (Mean likelihood = 4.3 (out of 5) at baseline, follow-up), and appears to have increased (Mean likelihood = 2.9 and 4.3 (out of 5), at baseline and follow-up) for incentive participants. Seventy-three percent of intervention group participants (8 out of 11) indicated the incentives helped them maintain their exercise program. The average incentive earning was \$11.63 per week. Fifty-five percent of all incentives were redeemed for grocery store vouchers and 13% were donated to Toronto Rehab.

Aerobic fitness, motivation and self-efficacy

Mean change in aerobic fitness (expressed as change (+/-) in ml/kg/min) was -0.68 (SD=3.33, Min=-5.11, Max=7.80) for controls, and $+0.23$ (SD=2.42, Min=-2.50, Max=4.90) for incentive group participants ($p>0.05$; Figure 6.1). As well, self-determined motivation and exercise self-efficacy endured over the course of the 12-week intervention (Table 6.2). Notably, the Relative Autonomy Index (a summary score for self-determined motivation) for intervention group participants was 46.6 and 49.0 (out of 80) at baseline and follow-up, respectively.

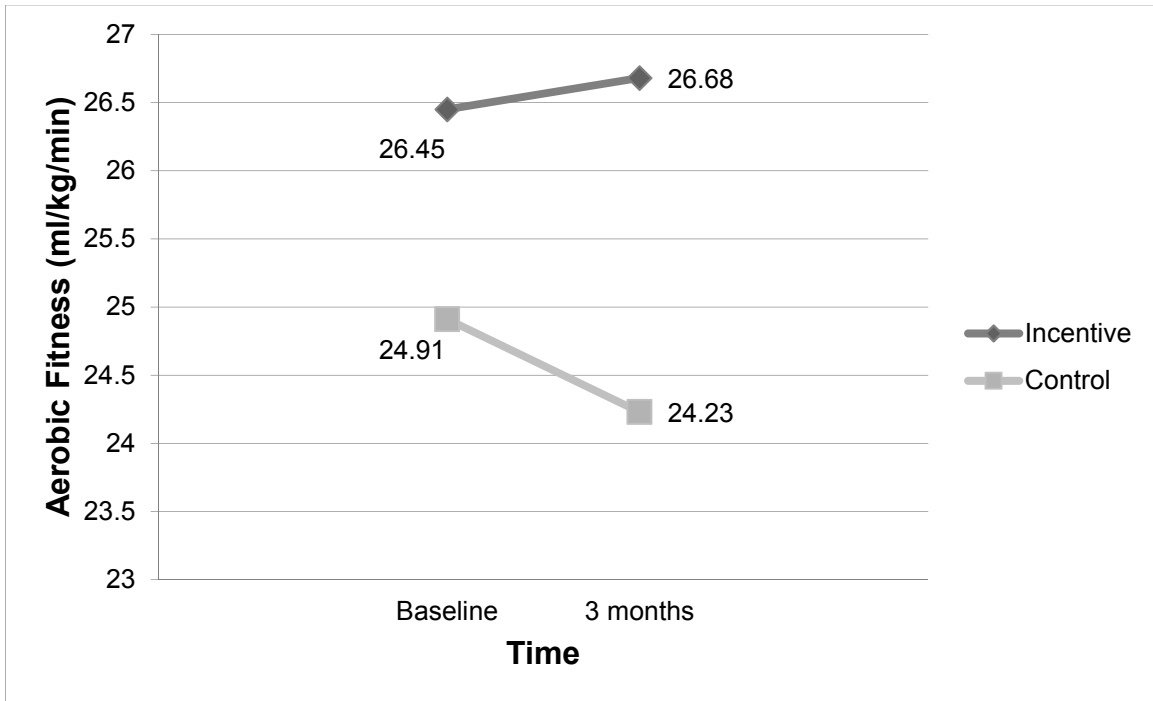


Figure 6.1. Baseline and follow-up aerobic fitness (mean) by study arm.

Table 6.2. Self-determined motivation and self-efficacy at baseline and three months.

	RAI		Barrier SE		Scheduling SE	
	Baseline	Follow-up	Baseline	Follow-up	Baseline	Follow-up
Control	45.2	46.6	5.8	5.4	8.4	8.0
Incentive	46.6	49.0	5.5	5.4	9.1	9.6

NOTE. Data are presented as means. The minimum/maximum scores for the Relative Autonomy Index, and barrier and scheduling self-efficacy are 0/80, 0/10 and 0/10, respectively.

Abbreviations: RAI, Relative Autonomy Index (motivation); SE, self-efficacy.

6.5 Discussion

The findings suggest that a definitive randomized trial testing incentives for exercise self-monitoring in a Canadian CR program would be feasible and well accepted. In addition to demonstrating feasibility by successfully recruiting, randomizing and retaining CR

graduates, the results of this study underscore the *potential* for using incentives to promote exercise in a CR context. In particular, incentives were perceived as an effective intervention component, with 75% of incentive recipients indicating that the vouchers helped them maintain their exercise program. Though group differences in self-monitoring (the incentive ‘target’) were not observed, modest (non-significant) changes in aerobic fitness were noted with fitness *increasing* by 0.23 ml/kg/min among incentive participants, and *decreasing* by 0.68 ml/kg/min among controls – consistent with the body of literature examining incentives for exercise (Mitchell et al. 2013; Strohacker et al. 2014). As well, the modest increase in RAI for intervention group participants is promising given concerns that incentives undermine intrinsic motivation.

To refine the study protocol, a number of methodological issues should be addressed. In terms of study enrolment, the 36.5% recruitment rate is two-times that normally observed for post-CR intervention studies at Toronto Rehab, suggesting recruitment to future trials is feasible. Nevertheless, a large segment of the target population (63.5%) did not enrol. One reason for this may have to do with our recruitment strategy (e.g., one short announcement to CR group vs. one-to-one recruiting). Though the group announcement may not have been as effective as other approaches, it allows us to predict intervention uptake in a ‘real-world’ setting, and identify barriers to implementation into clinical practice. Looking ahead, to boost enrolment and increase the generalizability of future research, the intervention should be refined to appeal to harder to engage CR sub-groups (e.g., older, retired adults). For instance, simplifying the online diary registration process and providing a short demonstration on-site, may increase participation.

Also, changes in aerobic fitness, the proposed primary outcome of a definitive trial, were more modest than expected. While a 10% drop in aerobic fitness can be expected after three months of inactivity (Katzel et al. 1997) (since, in the absence of extrinsic monitoring by CR staff, many graduates discontinue exercise) (Zullo et al. 2010), amongst controls, only a 3% reduction was observed (24.91 to 24.23 ml/kg/min). Several factors may have maintained control group fitness at artificially high levels, including the prospect of a fitness test in the near future (at 3 month study follow-up). For the incentive group, aerobic fitness was essentially maintained, increasing by about 1%. Future

research should examine whether incentives of similar magnitude (\$2/day) would increase fitness to a greater extent in a lower income sample (9 out of 13 intervention group participants reported household incomes greater than \$95,000). Higher income adults tend to be less sensitive to incentive intervention (John et al. 2012).

Regarding incentive design, a more thorough application of behavioral economics principles may help to optimize the intervention in the future. For example, increasing the immediacy of rewards (to better exploit the “present bias” that makes it hard for people to exercise daily), framing feedback statements using loss aversion language (to elicit potent feelings of regret and exploit people’s tendency to be “loss averse”), and offering lottery-based incentives on top of certain ones (to exploit people’s tendency to overweigh small probabilities, increasing the impact of a limited pool of incentives) may increase the overall effectiveness of the incentive program without significant additional investment.

Strengths and limitations

By targeting exercise self-monitoring (a key self-regulatory behavior in CR) incentives may have helped CR patients internalize the reasons to exercise, promoting the sustainability of the behavior. The simplicity of the approach (incentives for weekly exercise self-monitoring) was also well received, with high levels of program satisfaction and 80% retention. The low recruitment rate limits the generalizability of the results although this should be less of a concern given the feasibility nature of the study. The lack of available data for those who were recruited but did not sign-up for the study introduces selection bias as well. A third limitation is the modest observed changes in aerobic fitness. Conducting a longer (12 month) trial should maximize outcome responsiveness.

6.6 Conclusion

Data for a range of feasibility outcomes are presented. The authors also determined that a commercial incentive program could be delivered as intended with some suggestions on how to improve the intervention. The current study adds to the literature by setting the stage for a definitive RCT to test another application of incentives (voucher-based

incentives for exercise *self-monitoring*) in a new clinical population (CR graduates) in the broader context of the universal Canadian healthcare system.

Chapter 7

7 General Discussion

7.1 Overall findings

A growing evidence base, now including several systematic reviews of randomized trials, has shown that incentives generally improve ‘lifestyle’ health behaviours in the short-term (< 3 mo.) and while the incentives are still in place. Less research has examined the impact of incentives on exercise specifically, and little is known about the acceptability and effectiveness of incentives in Canadian health care. To extend the work of others, novel data are presented that support further development and study of incentives-for-exercise in a Canadian CR context. In addition, several methodological issues have emerged from this collection of inter-related studies that should be acknowledged and/or addressed in future studies. For example, little is still known about what various sub-populations (e.g., lower income or internally motivated CR graduates) think about incentive interventions. Targeting these population segments in other focus group studies, or conducting larger, cross-sectional studies may help fill this knowledge gap. Other important methodological concerns and suggestions for addressing them are described below. While this thesis provides a theoretical and empirical foundation from which to build future interventions and evaluation studies, building a business case for incentives in CR will take several more preparatory studies. Main findings, limitations, and areas for further inquiry, as well as the practical/theoretical contributions of this body of work, are presented next. An overview of study objectives and main findings is presented in Table 7.1.

7.2 Main findings, limitations and future research

In Chapter 2, a novel theoretical rationale for the sometimes-contentious incentives approach was presented, and an initial target for intervention identified – namely, the difficult transition for CR program graduates to community-based exercise (‘self-management’). Noteworthy was the consideration of self-determination theory in identifying incentive program designs that may be more likely to protect intrinsic

motivation and drive sustained behaviour change. Empirical studies are needed to determine whether the application of these promising design features (e.g., incentives for exercise self-monitoring, rather than exercise *per se*) would protect intrinsic motivation in this population.

Table 7.1 Study objectives and main findings.

	Primary Objective	Main Finding
<i>Chapter 3 – Systematic Review</i>	Examine efficacy of incentives-for-exercise.	Incentives stimulate short-term exercise; less evidence of long-term, sustained effects.
<i>Chapter 4 – Focus group study</i>	Explore opinions of incentives in Canadian CR context.	Opinions are contingent on design, with certain design features being more amenable.
<i>Chapter 5 – Questionnaire</i>	Develop a questionnaire to assess incentive acceptability and identify acceptability moderators.	Comprehensive, psychometrically sound questionnaire (26 items) developed.
<i>Chapter 6 – Feasibility RCT</i>	Test whole trial feasibility and report range of feasibility outcomes.	Incentives-for-exercise in CR warrant further study before embarking on a fully powered RCT.

Following a systematic review of the literature, a meta-analysis to determine the efficacy of incentives-for-exercise in adults was conducted (Chapter 3). In this meta-analysis of randomized trials (n=11, 594 participants), incentives increased exercise adherence 80% of the time, by about 12% on average (SD 5.61%, 17.50%; test for overall effect $z=3.81$, $p<0.0001$). The qualitative analysis suggests incentive effects were greater (increasing

exercise adherence by about 100%) in the presence of specific incentive design features (e.g., certain vs. uncertain (lottery) incentives; large vs. small incentives) or when targeting specific groups (e.g., physically inactive adults, low income adults), though there were too few studies to draw conclusions using meta-regression. Notably, very few of the included studies examined the long-term (> 6 mo.; n=1) and/or sustained (after incentives removed; n=2) effects of incentive intervention. Since the health economic benefits of exercise are usually reserved for those who sustain the behaviour for longer periods, more longitudinal research is needed. In addition, the systematic review excluded all non-randomized studies given their greater potential for selection bias. In doing so, the ability to learn more about successful, longer-term incentive programs, evaluated in the context of large workplace wellness programs via less rigorous, though still very valuable, prospective cohort and case-control studies, may have been limited. Another, more inclusive systematic review (with a similar search strategy) may provide valuable insight into the effectiveness of incentives-for-exercise in practice. Of interest to governments and corporations is the cost- and comparative cost-effectiveness of incentives compared with more traditional interventions (e.g., education, counseling). As more studies incorporate cost-effectiveness outcomes into their analyses, a systematic review of that evidence would be warranted as well.

Regardless of whether incentives produce short-term, long-term, or sustained effects, if they are not amenable to the target group they will almost certainly fail (Volpp et al. 2011) – either because of poor uptake or because they antagonize target groups. In Chapter 4, the results of a focus group study were presented. The main finding here was that opinions of incentives were not necessarily negative but were contingent on contextual factors. For instance, in the sample of graduating CR patients, voucher-based, health-promoting incentives (e.g., grocery vouchers, gym discounts, charitable donations) were well accepted, and the majority of respondents indicated that they would participate in an incentive program that rewarded them with ‘healthy vouchers’ to exercise. Still, the generalizability of these findings is limited and little is still known about the design features that may moderate opinions in different population segments. For example, 10 focus group participants reported incomes less than \$50,000 (Cnd.) and even fewer were single (not married), working, or 70+ years old, making it difficult to tailor interventions

for these traditionally hard to engage groups. Conducting focus groups that purposefully sample from these sub-populations, or larger survey studies that capture opinions from a more representative sample of CR graduates, may help to optimize the design of future incentive interventions.

Given the importance of gauging target group opinions of incentives, a questionnaire to facilitate the identification of preferred incentive program design features was developed (Chapter 5). The newly developed Health Incentive Program Questionnaire (HIP-Q; 23 items) is the most comprehensive questionnaire of its kind, building on previous attempts to explore incentive acceptability by (1) sampling a wider range of instrumental and affective attitudes, and by (2) measuring the effect of program features on the likelihood of incentive program participation. The HIP-Q demonstrated content, face and construct validity. Test-retest reliability was only partly supported, however, with 12 out of 23 items demonstrating ‘Good’ reliability ($ICC \geq 0.7$). Future refinement of item stems, format and response alternatives may improve test-retest reliability in the future. In this regard, additional feedback from other incentive and survey development experts, as well as CR patients, may be warranted. To adequately assess the reliability of a more refined version of this tool, a larger test-retest study will be required.

This thesis culminated in Chapter 6 where the results of an incentives feasibility study were presented. In addition to reporting a range of feasibility outcomes, including recruitment and retention rates and intervention acceptability, a number of methodological issues were outlined. Acknowledging and addressing these issues will be important moving forward with the optimization of interventions and study designs. Regarding the original proposed primary outcome of a definitive trial (i.e. aerobic fitness), the feasibility study underscored how aerobic fitness can persist in this CR population in the short-term (e.g., 3 mo.), regardless of study group assignment, especially if study participants are aware of the follow-up assessment. Though aerobic fitness is a powerful predictor of future health and longevity among CR graduates, it may be prudent from an evaluation perspective to use a more proximal behavioural outcome in future work (i.e. minutes of objectively assessed MVPA per week), with aerobic fitness and self-determined motivation being important, albeit, secondary outcomes. This will

make it easier to discern intervention effects, especially in the short-term (< 6 mo.), and aligns more closely with well-defined and commonly cited public health physical activity targets.

Regarding incentive program design, several opportunities for improvement were identified, including: (1) streamlining the web-user experience (see Appendix H), (2) reducing the incentive size to minimize extrinsic pressures (and protect intrinsic motivation) and increase the potential for scalability (i.e. from \$2/day to \$1/day), (3) introducing a ‘certain chance’ incentive design scheme to maximize impact of smaller incentives, since people tend to overweigh small probabilities (i.e. 1 in 3 chance of \$3 every day exercise is self-monitored), (4) introducing social comparison feedback, where participants are informed of how most of their peers are doing (e.g., “8 out of 10 grads submitted their diaries this week”), (5) framing feedback statements using loss aversion language (e.g., “You missed out on up to \$15 this week!), and (6) prompting all participants with a exercise diary submission deadline reminder each week. Though the feasibility study was valuable on several fronts (e.g., able to develop relationship with private sector partner, examine intervention acceptability, and explore whole trial feasibility), the design upgrades mentioned may significantly impact acceptability, uptake, and efficacy and thus warrant a new round of preliminary studies before conducting a more costly definitive trial.

Regarding study design, too many uncertainties remain to progress to a fully powered RCT at this time. For example, it is unclear how acceptable a re-vamped incentive program (described above) might be for the target group – is it still comprehensible, user friendly, potentially effective? Also, it is not known whether incentives can help maintain minutes of MVPA per week (the new proposed primary outcome of a definitive trial) at CR program graduation levels, and if these levels would persist after the incentive is withdrawn. The size of these effects is needed to perform sample size calculations for a definitive trial. It is important, in these still early stages of intervention development, to carefully track the influence of incentives on self-determined motivation as well, especially among those whose motivation is at higher risk of being undermined (e.g., RAI>60). Learning more about how incentives affect motivation in various CR sub-

groups (e.g., intrinsically motivated, high income) in larger pilot studies will inform the development of the main evaluation study. For example, it may turn out that placing incentives on already internally motivated CR graduates, despite best efforts to design incentives that protect motivation, may undermine this critical construct. If this proves to be the case, program-wide implementation may be more difficult and a time-consuming/costly RCT may not be warranted. Taken together, the results of this feasibility study suggest that incentives hold promise (e.g., 75% of incentive recipients said ‘it motivated them to track their exercise’), but that more preparatory work is required before progressing to a fully powered RCT.

7.3 Key contributions

7.3.1 Theoretical contributions

In this thesis it is argued that broader theoretical considerations regarding how incentives motivate human behaviour may help to optimize incentive interventions, as others have done (Burns et al. 2012; Mitchell and Faulkner 2012; Oliver 2012; Lynagh et al. 2013; Pope and Harvey 2015). Insights from self-determination theory in particular have helped in considering how incentives could be structured in a way that may not undermine intrinsic behavior (Chapter 2). According to self-determination theory, incentives will be harmful if they do not nurture the three basic psychological needs of competence, autonomy and social relatedness and in doing so protect or increase a person’s intrinsic motivation to exercise.

Incentives may help to build intrinsic motivation to exercise primarily through their action on self-efficacy (Biddle and Mutrie 2008). For example, incentives may increase a person’s self-efficacy to exercise by exposing them to a form of exercise for the first time. Especially if the contingent behaviour is a realistic one (e.g., walk for 5 minutes every day), individuals may find their confidence to exercise increases after just a few weeks. This ‘exposure’ hypothesis is best illustrated in the gym attendance literature, where incentives offered to previously inactive adults led to higher than baseline gym attendance after the incentives were removed (Charness and Gneezy 2009). Previously intimidated or unfamiliar gym members, for example, may not be as uncomfortable once

they have a few ‘incentive-inspired’ weeks of gym attendance under their belts (Pope and Harvey 2015). Interestingly, in the feasibility study described in Chapter 6, scheduling self-efficacy amongst incentive recipients trended upwards from 9.1 to 9.6 (out of 10) over the course of the 12-week intervention, though this increase was not statistically significant.

Incentives may also increase feelings of autonomy and social relatedness which can translate into more internalized motivations to exercise, though this still needs to be empirically tested. According to Moller et al. (2012), incentive programs that elicit the person’s perspective, provide a rationale for why the program is a good/effective option, provide choice, create supportive interpersonal climates (social relatedness), use non-controlling language, and limit deadlines, pressures, criticisms, and conditional praise (e.g., as incentives can be) are more autonomy promoting. Tying incentives to team goals or offering the option of donating incentives to charity may promote feelings of social relatedness as well.

It is speculated that only when incentives increase feelings of self-efficacy, autonomy and/or social relatedness will they help individuals internalize the reasons to exercise and promote sustained and clinically significant health behaviour change. To date far too little attention has been paid to these theoretical considerations in the design and evaluation of incentive programs and interventions/studies have suffered as a result. Two recent articles are notable exceptions: (1) “The impact of incentives on intrinsic and extrinsic motives for fitness-center attendance in college first-year students” (Pope and Harvey 2015) and (2) “Motivation for participating in a weight loss program and financial incentives: An analysis from a randomized trial” (Crane et al. 2012). Pope et al. (2015) determined that incentives worth \$10 to \$38.75 per week did not negatively impact intrinsic motives to exercise, and Crane et al. (2012) found that offering performance-based incentives (i.e. for weight loss) did not undermine intrinsic motivation.

Another contribution to the theoretical discussion of incentives includes postulating, for one of the first times (Mitchell and Faulkner 2012), that theoretically driven incentives may actually serve to build, rather than harm, intrinsic motivation to exercise (Chapter 2).

Drawing attention to one of only two randomized studies to track exercise into the critical post-incentive period (Chapter 3) and showing that incentives for exercise *self-monitoring* may protect intrinsic motivation in the feasibility study (Chapter 6) (other papers have recently implemented incentives for self-monitoring, as well) (Sen et al. 2014; Leahey et al. 2015), has helped debunk the commonly held belief that rewards “crowd out” intrinsic motivation in all, or most, cases. In fact, with exercise, because there is often little intrinsic motivation to begin with (Sweet et al. 2011; Promberger and Marteau 2013), incentives seem to be less likely to undermine self-determined motivation than previously thought. In acknowledging the potential for incentives to undermine intrinsic motivation, it is suggested that the threat may be larger for intrinsically (e.g., physically active) versus extrinsically (e.g., less physically active, or sedentary) motivated adults, although this remains to be empirically evaluated in a CR context. Deploying incentives to promote post-CR exercise adherence is different from other incentives-for-exercise interventions; CR graduates are already exercising regularly for the most part, and thus may have developed more/stronger intrinsic motives to exercise compared to otherwise healthy, community-dwelling adults. Learning more about the rise and/or fall of self-determined motivation during and after CR, and in the context of incentive intervention would be valuable in the development of future post-CR incentive interventions.

In summary, incentives designed to support the internalization process, a mechanism by which we can predict persistent exercise (Sweet et al. 2011), may have a role to play in promoting *quality*, self-determined (not externally controlled) exercise behaviours. This requires further empirical testing.

7.3.2 Practical contributions

Updating the list of incentive design features/attributes

The practical implications of this research are important given the growing popularity of incentive interventions. First, building on the work of others (Klein and Karlawish 2010; Adams et al. 2013) additions have been made to the list of core incentive program design features/attributes (see Table 5.1) such as type of assessment, duration of incentive

intervention, and incentive source. Although little is still known about ‘optimal’ incentive program design, considering, at the very least, the full range of features and attributes in the design process should increase chances of intervention success (Consensus Statement of the Health Enhancement Research et al. 2012). Also, incentive interventions can be difficult to evaluate, in part, because programs vary greatly in the design features/attributes employed. Framing evaluations around the full list of core feature/attributes will help to answer the question ‘which incentives work best in which situations?’.

Identifying ‘promising’ incentive-for-exercise designs

A growing body of research is starting to examine the impact of incentive design permutations on effectiveness. To promote sustained behaviour change, for example, two recent randomized trials have shown that smaller lottery-based incentives (i.e. \$1.40 per day vs. \$2.80 per day) and group-based rewards (vs. individual-based) were more likely to drive post-incentive medication adherence and weight loss, respectively (Kullgren et al. 2013; Sen et al. 2014). Much more research in this area is required, however, especially in the incentives-for-exercise domain. For example, it remains to be seen whether uncertain (lottery-based) incentives with a high probability of winning (e.g., 1 in 3 chance for \$3 vs. 1 in 100 chance for \$100) are more effective at increasing exercise adherence than certain incentives (e.g., \$1 for each gym visit). It may be that certain incentives are more effective with one demographic (e.g., very inactive adults), or at one point in time (e.g., exercise program initiation) and uncertain ones are more effective with another demographic (e.g., moderately active adults), or at another point in time (e.g., exercise maintenance).

To contribute to this conversation, and begin to answer the question which incentives work best in which situations?’, several promising design feature attributes were identified in the systematic review of incentives-for-exercise in Chapter 3. In particular, a qualitative review of the incentive design features of the studies included in the review (n=11) drew attention to attributes that *may* optimize interventions. The impact of modest incentives (\$5 to \$10 per week), it was concluded, could potentially be amplified with the

introduction of certain incentive design feature attributes, including (1) immediate and objective monitoring (e.g., card swipe at gym), (2) certain or ‘assured’ incentives (e.g., \$20 for 8 gym visits/mo.) and (3) deposit contract incentives (e.g., participants wager their own money). While uncertain (lottery-based) incentives did not stimulate exercise in the studies reviewed, it is plausible that the ‘perceived values’ of the incentives were not sufficient to promote exercise. For example, Wing *et al.* (1996) offered a 1 in 21 chance (less than 5% probability of winning) for a weekly draw of \$73.17, which did not increase walking session attendance. A low probability of winning, combined with a relatively modest incentive, may have limited incentive effectiveness. On this issue of ‘perceived value’, sometimes called the “marginal utility of money” (Burns *et al.* 2012), re-imburement type incentives (i.e. incentives to cover existing expenses like gym memberships, or the cost of groceries) may have been perceived as more valuable in two of the studies reviewed (Courneya *et al.* 1997; Daryanto *et al.* 2010) than researcher-derived voucher schemes or even cash payments of equal value, as has been previously reported (Lacetera and Macis 2010). While much research is still needed to clarify the conditions under which incentives reliably increase exercise, lessons can be learnt from the studies included in the systematic review.

Optimizing uptake with the HIP-Q

As the cost of health care for governments and corporations increases, decision makers cannot afford to implement interventions that are not readily accepted by target populations. Incentive programs that neglect individual- or group-level preferences (e.g., voucher preferences; willingness to wager own money) may not be getting the most ‘bang for their buck’, and may even antagonize target groups, limiting program enrolment. A novel contribution of this thesis is the development of the Health Incentive Program Questionnaire (HIP-Q). This questionnaire can be used by incentive program sponsors/designers to tailor incentive programs to maximize ‘acceptability’, and appeal, for target groups. This is the latest attempt to develop a novel incentive design tool, the first questionnaire to consider the broad range of incentive design features, and the first such tool to be psychometrically evaluated. Although the HIP-Q was developed in a CR context, there is no obvious reason it cannot be applied in other contexts and for other

health behaviors given its focus on core design features of incentives. Preferences may certainly vary across populations and contexts and further validation work will be needed to demonstrate this.

Development of the incentive-based ‘EX-TRACKER’

The incentive-driven, online exercise diary (currently called ‘EX-TRACKER’) that was developed with Cookson James Loyalty Inc. may provide the helpful, and accessible, infrastructure needed to drive continued exercise in a graduating CR population. Since participant attrition is a limitation of eHealth technologies, incentives may play a supporting role, potentially boosting EX-TRACKER registrations at graduation and sustaining engagement over longer periods (> 12 mo.). Deploying, testing, and improving promising health behaviour change techniques/technologies, such as incentives for an eHealth program, may help control common chronic disease risk factors (e.g., physical inactivity, BP, lipids). This approach is particularly promising, as it would require few resources to deliver (i.e. the program is automated) and has plenty of potential for population-wide implementation. Aligning very closely with UHN program structures (i.e. weekly diary submission during the program), the EX-TRACKER may also make for a more seamless transition to community-based exercise.

7.4 Future research

Given the sometimes-contentious nature of financial health incentive interventions, a theme for future research should focus on incentive ‘acceptability’, not only in the CR context but also in other clinical and workplace settings where primary and secondary prevention of chronic conditions is a goal. In order to sample as many opinions as possible regarding incentives (with adequate representation from various sub-populations), the HIP-Q should be deployed amongst graduating CR patients at Toronto Rehab but in other settings as well. A sample project is proposed that will begin to address this acceptability theme in an employee population.

To learn more about incentive acceptability and acceptability moderators (e.g., incentive design features), and leveraging relationships with private sector partners, a cross-

sectional computer survey study with a large sample of hospital employees will be conducted, the main objectives being to (1) assess the acceptability of incentives among a non-random sample of hospital employees and (2) explore factors associated with greater acceptability using the HIP-Q. Through a strategic partnership with Cookson James Loyalty Inc. (owners of a health rewards platform), Green Shield Canada (GSC) and HHS (10,000 employees) one thousand Hamilton Health Sciences Center (HHS) employees will be recruited to participate in the study. Overall acceptability will be the primary outcome, and the relationships between acceptability, incentive design features and important demographic (e.g., age, income) and health (e.g., weight status) characteristics will be secondary outcomes. The findings may be used to optimize HHS's new health incentive program, ultimately increasing return-on-investment.

In addition to exploring target group opinions and to set the stage for broad implementation it will be important to gauge the opinions of other stakeholders as well. Conducting focus group and survey studies to explore opinions and attitudes around incentive interventions among health care providers (e.g., cardiac rehab supervisors), payers (i.e. provincial governments, health insurers), and private sector funding partners (e.g., grocery stores, pharmaceutical companies) should inform the development of more acceptable, feasible, scalable and sustainable incentive interventions.

A properly powered RCT ('efficacy' trial) is needed to confirm the impact of theoretically driven incentives on exercise in a post-CR environment. According to the ORBIT model for behavioural treatment development however, several steps should be taken before embarking on a costly confirmatory trial (see Figure 7.1) (Czajkowski et al. 2015). For instance, while this thesis has helped identify a hypothesized pathway by which incentives can solve the problem of poor post-CR exercise adherence, established a scientific evidence base for the central treatment component (i.e. incentives), and explored target group opinions, a number of questions still remain, including: (1) What incentive design features moderate acceptability in traditionally hard to engage CR program graduates (e.g., low income, older, single adults), (2) How will 'upgrading' the intervention using insights from behavioral economics and self-determination theory impact intervention acceptability and/or safety (i.e. does it undermine motivation)? (3)

How will offering the web-based exercise diary only (as opposed to web-based *and* paper diary options, as was done in the feasibility study) affect recruitment and retention rates? (4) Will the new intervention, or ‘treatment package’, achieve a clinically significant signal on minutes of MVPA per week, the new proposed primary outcome of a definitive trial? (5) What incentive dose and duration is needed to promote sustained behaviour change in this population? (6) How long should the study follow-up period be to detect behavioural decay? (7) Who should be the initial target for intervention (i.e. all CR graduates or only CR graduates placing lower on the RAI)?

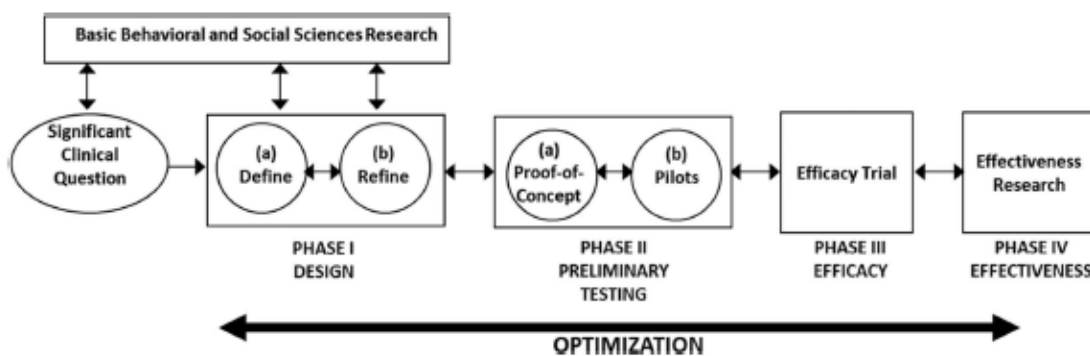


Figure 7.1. The ORBIT model for behavioural treatment development (p. 3) (Czajkowski et al. 2015).

It is possible that conducting the feasibility RCT in Chapter 6 was premature given all the uncertainties that still remain. However, as illustrated in Figure 7.1, the development of behavioural treatments should be an iterative process, moving back and forth between phases, until there is satisfaction that a treatment package is complete and a fixed protocol is ready for testing. Although incentive interventions could conceivably be adjusted and improved upon indefinitely, clearly some preparatory work is still required. The next phase(s) in this line of research, according to the ORBIT model, should probably include a combination of Phase I (b) Treatment Package Refinement Research and Phase II (a) Proof-of-Concept Preliminary Testing. Focus groups and surveys should be used to identify acceptability moderators to further optimize the intervention. A quasi-experimental, single cohort pre-post study design should be used to identify acceptability in a ‘real world’ setting, as well as determine the impact of incentives on minutes of

MVPA per week and self-determined motivation. Causality cannot be definitively demonstrated with a quasi-experimental study design, however, this preliminary work will strengthen the intervention, increasing confidence that it can be delivered as intended, allowing for safer effect size and variability estimates, and making it easier to evaluate in a research setting. Cost-effectiveness studies should eventually follow in order to make a business case for incentives in a CR context. Cost-effectiveness studies conducted by Papadakis et al. (2008) and Leahey et al. (2015), for CR and incentives-for-weight loss, respectively, could be used to guide the development of a future cost-effectiveness analysis of an incentives-in-CR RCT.

7.5 Conclusions

The overarching objective of this line of work will continue to be to improve the long-term maintenance of exercise in a cardiac population through a better understanding of how to structure, implement and evaluate ‘acceptable’ and effective incentive programs. Given their potential to produce sustained health behaviour changes in general, lessons learned in the CR context could be applied to other clinical/workplace settings as well where patient/employee adherence to health behaviours could be improved. The transition from formal, supervised CR to independent, community-based exercise is a very difficult one. At the UHN Cardiovascular Prevention and Rehabilitation Program alone, anywhere from 600 to 1900 CR program graduates discontinue their regular exercise routine within a year of program completion. At the end of CR, patients are transitioned back to their family doctors who are very busy and likely do not have the time or expertise to promote exercise maintenance. While UHN’s program offers a suite of graduate engagement opportunities to support this transition (e.g., grad drop-ins, monthly education) only about 1-2% of graduates participate. One reason for this may have to do with the limited ‘accessibility’ of these programs. For instance, the bulk of UHN’s graduate programs require travel to the center, and for patients with limited time, disposable income, and vehicle access, the offerings are not overly accessible. While recent attempts to harness the great accessibility and reach of the Internet to promote self-management among UHN CR graduates are laudable (i.e., www.takechargeonline.ca

launched in September 2014), there is room for improvement. In particular, shifting the online focus from education, to motivation and facilitation may prove to be effective. Incentives are not a panacea, of course. They may work for some, but not others, and ideally are only required until graduates internalize the reasons to exercise ('I walk because I enjoy it.'). As part of a broader package of interventions, however, this thesis suggests incentives *may* have a role to play in stimulating and sustaining exercise in a CR population, and warrant further study.

References

- Adams, J., E. L. Gilles, E. McColl and F. F. Sniehotta (2013). "Carrots, sticks and health behaviours: A framework for documenting the complexity of financial incentive interventions to change health behaviours." Health Psychology **8**(3): 100-110.
- Ades, P. A. (2001). "Cardiac rehabilitation and secondary prevention of coronary heart disease." New England Journal of Medicine **345**(12): 892-902.
- Ades, P. A. and D. E. Gaalema (2012). "Coronary heart disease as a case study in prevention: potential role of incentives." Prev Med **55** *Suppl*: S75-79.
- Alter, D. A., P. I. Oh and A. Chong (2009). "Relationship between cardiac rehabilitation and survival after acute cardiac hospitalization within a universal health care system." European Journal of Cardiovascular Prevention & Rehabilitation **16**(1): 102-113.
- Alter, D. A., B. Zagorski, S. Marzolini, M. Forhan and P. I. Oh (2014). "On-site programmatic attendance to cardiac rehabilitation and the healthy-adherer effect." Eur J Prev Cardiol.
- Bentley, D., S. Khan, P. Oh, S. Grace and S. Thomas (2013). "Physical activity behavior two to six years following cardiac rehabilitation: a socioecological analysis." Clinical Cardiology **36**(2): 96-102.
- Berent, R., S. P. von Duvillard, J. Auer, H. Sinzinger and P. Schmid (2010). "Lack of supervision after residential cardiac rehabilitation increases cardiovascular risk factors." European Journal of Cardiovascular Prevention & Rehabilitation **17**(3): 296-302.
- Biddle, S. J. H. and N. Mutrie (2008). Psychology of Physical Activity. New York, Routledge.
- Blair, S. N., H. W. Kohl, 3rd, R. S. Paffenbarger, Jr., D. G. Clark, K. H. Cooper and L. W. Gibbons (1989). "Physical fitness and all-cause mortality. A prospective study of healthy men and women." JAMA **262**(17): 2395-2401.
- Blondon, K., P. Klasnja, K. Coleman and W. Pratt (2014). "An exploration of attitudes toward the use of patient incentives to support diabetes self-management." Psychol Health **29**(5): 552-563.
- Blum, M. R., J. P. Schmid, P. Eser and H. Saner (2013). "Long-term results of a 12-week comprehensive ambulatory cardiac rehabilitation program." Journal of Cardiopulmonary Rehabilitation & Prevention **33**(2): 84-90.

Bock, B. C., R. E. Carmona-Barros, J. L. Esler and P. L. Tilkemeier (2003). "Program participation and physical activity maintenance after cardiac rehabilitation." Behavior Modification **27**(1): 37-53.

Bonevski, B., J. Bryant, M. Lynagh and C. Paul (2012). "Money as motivation to quit: a survey of a non-random Australian sample of socially disadvantaged smokers' views of the acceptability of cash incentives." Prev Med **55**(2): 122-126.

Bonevski, B., J. Bryant and C. Paul (2011). "Encouraging smoking cessation among disadvantaged groups: a qualitative study of the financial aspects of cessation." Drug & Alcohol Review **30**(4): 411-418.

Braun, V. and V. Clarke (2006). "Using thematic analysis in psychology." Qual Res Psych **3**(2): 77-101.

Burns, R., A. Donovan, R. Ackerman, E. Finch, A. Rothman and R. Jeffery (2012). "A theoretically grounded systematic review of material incentives for weight loss: Implications for interventions." Ann Behav Med.

Burton, W. N., C. Y. Chen, X. Li, A. B. Schultz and H. Abrahamsson (2014). "The association of self-reported employee physical activity with metabolic syndrome, health care costs, absenteeism, and presenteeism." J Occup Env Med **56**(9): 919-926.

Butler, L., S. Furber, P. Phongsavan, A. Mark and A. Bauman (2009). "Effects of a pedometer-based intervention on physical activity levels after cardiac rehabilitation: a randomized controlled trial." Journal of Cardiopulmonary Rehabilitation & Prevention **29**(2): 105-114.

Cahill, K. and R. Perera (2011). "Competitions and incentives for smoking cessation." Cochrane Database Syst Rev(4): CD004307.

Camerer, C. F. and G. Loewenstein (2003). Behavioral Economics: Past, Present, Future. Advances in Behavioral Economics. C. F. Camerer, G. Loewenstein and M. Rabin. Princeton, Princeton University Press.

Charness, G. and U. Gneezy (2009). "Incentives to Exercise." Econometrica **77**(3): 909-931.

Chase, J. A. (2011). "Systematic review of physical activity intervention studies after cardiac rehabilitation." Journal of Cardiovascular Nursing **26**(5): 351-358.

Consensus Statement of the Health Enhancement Research, O., O. American College of, M. Environmental, S. American Cancer, N. American Cancer Society Cancer Action, A. American Diabetes and A. American Heart (2012). "Guidance for a reasonably designed, employer-sponsored wellness program using outcomes-based incentives." Occup Environ Med **54**(7): 889-896.

Courneya, K. S., P. A. Estabrooks and C. R. Nigg (1997). "A simple reinforcement strategy for increasing attendance at a fitness facility." Health Educ Behav **24**(6): 708-715.

Crane, M. M., D. F. Tate, E. A. Finkelstein and L. A. Linnan (2012). "Motivation for participating in a weight loss program and financial incentives: An analysis from a randomized trial." Journal of Obesity **2012**(290589).

Czajkowski, S. M., L. H. Powell, N. Adler, S. Naar-King, K. D. Reynolds, C. M. Hunter, B. Laraia, D. H. Olster, F. M. Perna, J. C. Peterson, E. Epel, J. E. Boyington and M. E. Charlson (2015). "From Ideas to Efficacy: The ORBIT Model for Developing Behavioral Treatments for Chronic Diseases." Health Psychology: No Pagination Specified.

Daryanto, A., K. de Ruyter, M. Wetzels and P. G. Patterson (2010). "Service firms and customer loyalty programs: a regulatory fit perspective of reward preferences in a health club setting." JAMS **38**(5): 604-616.

de Melo Ghisi, G. L., P. Oh, M. Benetti and S. L. Grace (2013). "Barriers to cardiac rehabilitation use in Canada versus Brazil." Journal of Cardiopulmonary Rehabilitation & Prevention **33**(3): 173-179.

Deci, E. and R. Ryan (1985). Intrinsic motivation and self-determination in human behaviour. New York, Plenum Press.

Deci, E. and R. Ryan (2002). Handbook of self-determination research. Rochester, NY, University of Rochester Press.

Deci, E. L., R. Koestner and R. M. Ryan (1999). "A meta-analytic review of experiments examining the effects of extrinsic rewards on intrinsic motivation." Psychol Bull **125**(6): 627-668.

DeFulio, A. and K. Silverman (2012). "The use of incentives to reinforce medication adherence." Prev Med **55 Suppl**: S86-94.

Dolan, P., M. Hallsworth, D. Halpern, D. King and I. Vlaev (2010). MINDSPACE: Influencing Behaviour through Public Policy. London, The Cabinet Office and the Institute for Government.

EPHPP. (1998). "Quality Assessment Tool for Quantitative Studies." Retrieved November 2012, from <http://www.ephpp.ca/Tools.html>.

Epstein, L. H., R. R. Wing, J. K. Thompson and W. Griffin (1980). "Attendance and fitness in aerobic exercise: The effects of contract and lottery procedures." Behav Modif **4**(4): 465-479.

Faulkner, G. E. J., P. Grootendorst, V. H. Nguyen, T. Andreyeva, K. Arbour-Nicotopoulos, M. C. Auld, S. B. Cash, J. Cawley, P. Donnelly, A. Drewnowski, L. Dube, R. Ferrence, I. Janssen, J. Lafrance, D. Lakdawalla, R. Mendelsen, L. M. Powell, W. B.

Traill and F. Windmeijer (2011). "Economic instruments for obesity prevention: results of a scoping review and modified Delphi survey." International Journal of Behavioral Nutrition & Physical Activity **8**: 109.

Finkelstein, E. A., D. S. Brown, D. R. Brown and D. M. Buchner (2008). "A randomized study of financial incentives to increase physical activity among sedentary older adults." Prev Med **47**(2): 182-187.

Fong, G. T., A. Hyland, R. Borland, D. Hammond, G. Hastings, A. McNeill, S. Anderson, K. M. Cummings, S. Allwright, M. Mulcahy, F. Howell, L. Clancy, M. E. Thompson, G. Connolly and P. Driezen (2006). "Reductions in tobacco smoke pollution and increases in support for smoke-free public places following the implementation of comprehensive smoke-free workplace legislation in the Republic of Ireland: findings from the ITC Ireland/UK Survey." Tobacco Control **15 Suppl 3**: iii51-58.

Gilles, E. L. (2014).

Gomel, M., B. Oldenburg, J. M. Simpson and N. Owen (1993). "Work-site cardiovascular risk reduction: a randomized trial of health risk assessment, education, counseling, and incentives." Am J Public Health **83**(9): 1231-1238.

Grace, S. L., C. Chessex, H. Arthur, S. Chan, C. Cyr, W. Dafoe, M. Juneau, P. Oh and N. Suskin (2011). "Systematizing Inpatient Referral to Cardiac Rehabilitation 2010: Canadian association of cardiac rehabilitation and Canadian cardiovascular society joint position paper." Journal of Cardiopulmonary Rehabilitation & Prevention **31**(3): E1-8.

Hammill, B. G., L. H. Curtis, K. A. Schulman and D. J. Whellan (2010). "Relationship between cardiac rehabilitation and long-term risks of death and myocardial infarction among elderly Medicare beneficiaries." Circulation **121**(1): 63-70.

Hanks, A. S., D. R. Just, L. E. Smith and B. Wansink (2012). "Healthy convenience: nudging students toward healthier choices in the lunchroom." Journal of Public Health **34**(3): 370-376.

Higgins, S. T., D. D. Delaney, A. J. Budney, W. K. Bickel and et al. (1991). "A behavioral approach to achieving initial cocaine abstinence." Am J Psychiatry **148**(9): 1218-1224.

HSF (2010). "Perfect Storm."

Hunter, R. F., M. A. Tully, M. Davis, M. Stevenson and F. Kee (2013). "Physical activity loyalty cards for behavior change: a quasi-experimental study." Am J Prev Med **45**(1): 56-63.

Jeffery, R. (2012). "Financial Incentives and Weight Control." Prev Med **55**: 7.

- Jeffery, R., W. Bjornson-Benson, B. Rosenthal, C. Kurth and M. Dunn (1984). "Effectiveness of monetary contracts with two repayment schedules on weight reduction in men and women from self-referred and population samples." Behav Ther **15**: 273-279.
- Jeffery, R., C. Thorson, R. Wing and L. Burton (1998). "Use of personal trainers and financial incentives to increase exercise in a behavioral weight-loss program." J Consult Clin Psychol **66**(5): 777-783.
- Jeffery, R. W. and S. A. French (1999). "Preventing weight gain in adults: The Pound of Prevention study." Am J Public Health **89**(5): 747-751.
- Jeffery, R. W., R. R. Wing, C. Thorson and L. R. Burton (1998). "Use of personal trainers and financial incentives to increase exercise in a behavioral weight-loss program." Journal of Consulting & Clinical Psychology **66**(5): 777-783.
- Jeffery, R. W., R. R. Wing, C. Thorson and L. R. Burton (1998). "Use of personal trainers and financial incentives to increase exercise in a behavioral weight-loss program." Journal of consulting and clinical psychology **66**(5): 777-783.
- Jeffery, R. W., R. R. Wing, C. Thorson, L. R. Burton, C. Raether, J. Harvey and M. Mullen (1993). "Strengthening behavioral interventions for weight-loss - a randomized trial of food provision and monetary Incentives." J Consult Clin Psychol **61**(6): 1038-1045.
- John, L. K., G. Loewenstein, A. B. Troxel, L. Norton, J. E. Fassbender and K. G. Volpp (2011). "Financial incentives for extended weight loss: a randomized, controlled trial." J of Gen Intern Med **26**(6): 621-626.
- John, L. K., G. Loewenstein and K. G. Volpp (2012). "Empirical observations on longer-term use of incentives for weight loss." Prev Med **55**(Suppl): S68-S74.
- Jolliffe, J. A., K. Rees, R. S. Taylor, D. Thompson, N. Oldridge and S. Ebrahim (2001). "Exercise-based rehabilitation for coronary heart disease." Cochrane Database of Systematic Reviews(1): CD001800.
- Julious, S. A. (2005). "Sample size of 12 per group rule of thumb for a pilot study." Pharm Stat **4**(4): 287-291.
- Kane, R. L., P. E. Johnson, R. J. Town and M. Butler (2004). "A structured review of the effect of economic incentives on consumers' preventive behavior." Am J Prev Med **27**(4): 327-352.
- Katzel, L. I., M. J. Busby-Whitehead, J. M. Hagberg and J. L. Fleg (1997). "Abnormal exercise electrocardiograms in master athletes after three months of deconditioning." J Am Geriatr Soc **45**(6): 744-746.

Klein, E. and J. Karlawish (2010). "Challenges and opportunities for developing and implementing incentives to improve health-related behaviors in older adults." J Am Geriatr Soc **58**(9): 1758-1763.

Kullgren, J. T., A. B. Troxel, G. Loewenstein, D. A. Asch, L. A. Norton, L. Wesby, Y. Tao, J. Zhu and K. G. Volpp (2013). "Individual- versus group-based financial incentives for weight loss: a randomized, controlled trial." Annals of Internal Medicine **158**(7): 505-514.

Lacetera, N. and M. Macis (2010). "Do all material incentives for pro-social activities backfire? The response to cash and non-cash incentives for blood donations." J Econ Psychol **31**(4): 738-748.

Lavie, C. J. and R. V. Milani (2011). "Cardiac rehabilitation and exercise training in secondary coronary heart disease prevention." Prog Cardiovas Dis **53**(6): 397-403.

Leahey, T. M., L. L. Subak, J. Fava, M. Schembri, G. Thomas, X. Xu, K. Krupel, K. Kent, K. Boguszewski, R. Kumar, B. Weinberg and R. Wing (2015). "Benefits of adding small financial incentives or optional group meetings to a web-based statewide obesity initiative." Obesity **23**(1): 70-76.

Lee, I. M., E. J. Shiroma, F. Lobelo, P. Puska, S. N. Blair, P. T. Katzmarzyk and G. Lancet Physical Activity Series Working (2012). "Effect of physical inactivity on major non-communicable diseases worldwide: an analysis of burden of disease and life expectancy." Lancet **380**(9838): 219-229.

Leslie, M. and P. A. Schuster (1991). "The effect of contingency contracting on adherence and knowledge of exercise regimens." Patient Education and Counseling **18**(3): 231-241.

Loewenstein, G., D. A. Asch and K. G. Volpp (2013). "Behavioral economics holds potential to deliver better results for patients, insurers, and employers." Health Affairs **32**(7): 1244-1250.

Long, J. A., M. Helweg-Larsen and K. G. Volpp (2008). "Patient opinions regarding 'pay for performance for patients'." J Gen Intern Med **23**(10): 1647-1652.

Long, J. A., M. Helweg-Larsen and K. G. Volpp (2008). "Patient opinions regarding 'pay for performance for patients'." Journal of General Internal Medicine **23**(10): 1647-1652.

Lunze, K. and M. K. Paasche-Orlow (2013). "Financial incentives for healthy behavior: ethical safeguards for behavioral economics." Am J Prev Med **44**(6): 659-665.

Lynagh, M., B. Bonevski, I. Symonds and R. W. Sanson-Fisher (2011). "Paying women to quit smoking during pregnancy? Acceptability among pregnant women." Nicotine & Tobacco Research **13**(11): 1029-1036.

Lynagh, M. C., R. W. Sanson-Fisher and B. Bonevski (2013). "What's Good for the Goose is Good for the Gander. Guiding Principles for the Use of Financial Incentives in Health Behaviour Change." Int J Behav Med **20**(1): 114-120.

Madison, K., H. Schmidt and K. G. Volpp (2013). "Smoking, obesity, health insurance, and health incentives in the Affordable Care Act." JAMA **310**(2): 143-144.

Marquez, D. X., G. J. Jerome, E. McAuley, E. M. Snook and S. Canaklisova (2002). "Self-efficacy manipulation and state anxiety responses to exercise in low active women." Psychology & Health **17**(6): 783-791.

Martin, A., M. Suhrcke and D. Ogilvie (2012). "Financial incentives to promote active travel: an evidence review and economic framework." Am J Prev Med **43**(6): e45-57.

Martin, B. J., T. Hauer, R. Arena, L. D. Austford, P. D. Galbraith, A. M. Lewin, M. L. Knudtson, W. A. Ghali, J. A. Stone and S. G. Aggarwal (2012). "Cardiac rehabilitation attendance and outcomes in coronary artery disease patients." Circulation **126**(6): 677-687.

Michie, S., C. Abraham, C. Whittington, J. McAteer and S. Gupta (2009). "Effective techniques in healthy eating and physical activity interventions: a meta-regression." Health Psychol **28**(6): 690-701.

Mitchell, M. and G. Faulkner (2012). "A "Nudge" at All? The jury is still out on financial health incentives." Healthc Pap **12**(4): 31-36.

Mitchell, M., J. M. Goodman, D. A. Alter, L. K. John, P. I. Oh, M. T. Pakosh and G. E. J. Faulkner (2013). "Financial incentives for exercise adherence in adults: Systematic review and meta-analysis." Am J Prev Med **45**(5): 658-667.

Mitchell, M. S. and G. E. Faulkner (2014). "On supplementing "Foot in the door" incentives for eHealth program engagement." J Med Internet Res **16**(7): e179.

Mitchell, M. S., J. M. Goodman, D. A. Alter, P. I. Oh and G. E. Faulkner (2014). "'Will walk for groceries': Acceptability of financial health incentives among Canadian cardiac rehabilitation patients." Psychol Health **29**(9): 1032-1043.

Moher, D., A. Liberati, J. Tetzlaff and D. Altman (2009). "Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement." PLoS Med **6**(6).

Moller, A. C., H. G. McFadden, D. Hedeker and B. Spring (2012). "Financial motivation undermines maintenance in an intensive diet and activity intervention." J Obes **2012**: 1-8.

Moore, S. M., M. A. Dolansky, C. M. Ruland, F. J. Pashkow and G. G. Blackburn (2003). "Predictors of women's exercise maintenance after cardiac rehabilitation." Journal of Cardiopulmonary Rehabilitation **23**(1): 40-49.

Morgan, D. L. (1996). "Focus Groups." Annu Rev Sociol **22**: 129-152.

- MRC (2000). A Framework for development and evaluation of RCTs for Complex Interventions to Improve Health. United Kingdom, MRC.
- NBGH (2010). Large Employers' 2011 Health Plan Design Changes. N. B. G. o. Health. Washington, D.C.
- NBGH, T. W. (2014). The New Health Care Imperative: Driving Performance, Connecting to Value. 19th Annual Towers Watson/National Business Group on Health Employer Survey on Purchasing Value in Health Care. United States.
- Noland, M. P. (1989). "The effects of self-monitoring and reinforcement on exercise adherence." Res Q Exerc Sport **60**(3): 216-224.
- O'Connell, S. (2014). "Barriers to attending cardiac rehabilitation." Nursing Times **110**(19): 15-17.
- Oldridge, N., W. Furlong, D. Feeny, G. Torrance, G. Guyatt, J. Crowe and N. Jones (1993). "Economic evaluation of cardiac rehabilitation soon after acute myocardial infarction." American Journal of Cardiology **72**(2): 154-161.
- Oliver, A. (2012). Healthc Pap.
- Oliver, A. (2012). "A Nudge too far? A Nudge at all? On paying people to be healthy." Health Care Papers **12**(4).
- Organization, W. H. (2014). Global Status Report on Non-Communicable Diseases 2014.
- Pack, Q. R., L. L. Johnson, L. M. Barr, S. R. Daniels, A. D. Wolter, R. W. Squires, C. M. Perez-Terzic and R. J. Thomas (2013). "Improving cardiac rehabilitation attendance and completion through quality improvement activities and a motivational program." J Cardiopulm Rehabil Prev **33**(3): 153-159.
- Papadakis, S., R. D. Reid, D. Coyle, L. Beaton, D. Angus and N. Oldridge (2008). "Cost-effectiveness of cardiac rehabilitation program delivery models in patients at varying cardiac risk, reason for referral, and sex." European Journal of Cardiovascular Prevention & Rehabilitation **15**(3): 347-353.
- Park, J. D., J. Metlay, J. M. Asch and D. A. Asch (2012). "The New York Times readers' opinions about paying people to take their medicine." Health Educ Behav **39**(6): 725-731.
- Park, J. D., N. Mitra and D. A. Asch (2012). "Public opinion about financial incentives for smoking cessation." Prev Med **55** Suppl: S41-45.
- Paul-Ebhohimhen, V. and A. Avenell (2008). "Systematic review of the use of financial incentives in treatments for obesity and overweight." Obes Rev **9**(4): 355-367.
- Paul-Ebhohimhen, V. and A. Avenell (2008). "Systematic review of the use of financial incentives in treatments for obesity and overweight." Obesity Reviews **9**(4): 355-367.

Petter, M., C. Blanchard, K. A. Kemp, A. S. Mazoff and S. N. Ferrier (2009). "Correlates of exercise among coronary heart disease patients: review, implications and future directions." European Journal of Cardiovascular Prevention & Rehabilitation **16**(5): 515-526.

PHAC (2009). Tracking Heart Disease and Stroke in Canada.

PHAC. (2013). "Harper Government Partners with AIR Miles Reward Program and YMCAs in Canada to Promote Healthy Living." Retrieved June 15, 2014, from http://www.phac-aspc.gc.ca/media/nr-rp/2013/2013_0220-eng.php.

Piepoli, M. F., C. Davos, D. P. Francis, A. J. Coats and M. C. ExTra (2004). "Exercise training meta-analysis of trials in patients with chronic heart failure (ExTraMATCH)." BMJ **328**(7433): 189.

Pinto, B. M., M. G. Goldstein, G. D. Papandonatos, N. Farrell, P. Tilkemeier, B. H. Marcus and J. F. Todaro (2011). "Maintenance of exercise after phase II cardiac rehabilitation: a randomized controlled trial." American Journal of Preventive Medicine **41**(3): 274-283.

Pope, L. and J. Harvey (2015). "The impact of incentives on intrinsic and extrinsic motives for fitness-center attendance in college first-year students." American Journal of Health Promotion **29**(3): 192-199.

Pope, L. and J. Harvey-Berino (2013). "Burn and earn: A randomized controlled trial incentivizing exercise during fall semester for college first-year students." Prev Med **56**(3-4): 197-201.

Priebe, S., J. Sinclair, A. Burton, S. Marougka, J. Larsen, M. Firn and R. Ashcroft (2010). "Acceptability of offering financial incentives to achieve medication adherence in patients with severe mental illness: a focus group study." J Med Ethics **36**(8): 463-468.

Prochaska, J. and C. DiClemente (1992). Stages of Change in the Modification of Problem Behaviors. Newbury Park, CA, Sage.

Promberger, M., R. C. H. Brown, R. E. Ashcroft and T. M. Marteau (2011). "Acceptability of financial incentives to improve health outcomes in UK and US samples." J Med Ethics **37**(11): 682-687.

Promberger, M., P. Dolan and T. M. Marteau (2012). ""Pay them if it works": discrete choice experiments on the acceptability of financial incentives to change health related behaviour." Soc Sci Med **75**(12): 2509-2514.

Promberger, M. and T. M. Marteau (2013). "When do financial incentives reduce intrinsic motivation? comparing behaviors studied in psychological and economic literatures." Health Psychol **32**(9): 950-957.

- Purnell, J. Q., R. Gernes, R. Stein, M. S. Sherraden and A. Knoblock-Hahn (2014). "A systematic review of financial incentives for dietary behavior change." Journal of the Academy of Nutrition & Dietetics **114**(7): 1023-1035.
- Quigley, H. A. (2015). "Reminder systems, not education, improve glaucoma adherence: a comment on cook et Al." Annals of Behavioral Medicine **49**(1): 5-6.
- Rice, T. (2013). "The behavioral economics of health and health care." Annu Rev Public Health(34): 12.11-12.17.
- Ries, N. (2012). "Financial incentives for weight loss and healthy behaviours." Healthc Pap **7**(3): 5.
- Ross, R. and P. M. Janiszewski (2008). "Is weight loss the optimal target for obesity-related cardiovascular disease risk reduction?" Can J Cardiol **24 Suppl D**: 25D-31D.
- Sanofi (2013). The 2013 Sanofi Canada Health Care Survey.
- Schmidt, H., S. Stock and T. Doran (2012). "Issues in international health policy: moving forward with wellness incentives under the Affordable Care Act: lessons from Germany." Issue Brief (Commonwealth Fund) **13**: 1-12.
- Sen, A. P., T. B. Sewell, E. B. Riley, B. Stearman, S. L. Bellamy, M. F. Hu, Y. Tao, J. Zhu, J. D. Park, G. Loewenstein, D. A. Asch and K. G. Volpp (2014). "Financial incentives for home-based health monitoring: a randomized controlled trial." Journal of General Internal Medicine **29**(5): 770-777.
- Shanmugasegaram, S., P. Oh, R. D. Reid, T. McCumber and S. L. Grace (2013). "Cardiac rehabilitation barriers by rurality and socioeconomic status: a cross-sectional study." Int J Equity Health **12**: 72.
- Shanmugasegaram, S., P. Oh, R. D. Reid, T. McCumber and S. L. Grace (2013). "Cardiac rehabilitation barriers by rurality and socioeconomic status: a cross-sectional study." International Journal for Equity in Health **12**: 72.
- Shanmugasegaram, S., P. Oh, R. D. Reid, T. McCumber and S. L. Grace (2013). "A comparison of barriers to use of home- versus site-based cardiac rehabilitation." Journal of Cardiopulmonary Rehabilitation & Prevention **33**(5): 297-302.
- Shields, M., M. S. Tremblay, M. Laviolette, C. L. Craig, I. Janssen and S. C. Gorber (2010). "Fitness of Canadian adults: results from the 2007-2009 Canadian Health Measures Survey." Health Reports **21**(1): 21-35.
- Slovinec D'Angelo, M. E., L. G. Pelletier, R. D. Reid and V. Huta (2014). "The roles of self-efficacy and motivation in the prediction of short- and long-term adherence to exercise among patients with coronary heart disease." Health Psychology **33**(11): 1344-1353.

Stock, S., H. Schmidt, G. Buscher, A. Gerber, A. Drabik, C. Graf, M. Lungen and B. Stollenwerk (2010). "Financial incentives in the German Statutory Health Insurance: new findings, new questions." Health Policy **96**(1): 51-56.

Streiner, D. and G. Norman (2008). Health Measurement Scales: A practical guide to their development and use New York, Oxford University Press.

Strohacker, K., O. Galarraga and D. M. Williams (2014). "The impact of incentives on exercise behavior: a systematic review of randomized controlled trials." Ann Behav Med **48**(1): 92-99.

Sturm, R., R. An, D. Segal and D. Patel (2013). "A cash-back rebate program for healthy food purchases in South Africa: results from scanner data." Am J Prev Med **44**(6): 567-572.

Sutherland, K., J. B. Christianson and S. Leatherman (2008). "Impact of targeted financial incentives on personal health behavior: a review of the literature." Medical Care Research & Review **65**(6 Suppl): 36S-78S.

Sweet, S. N., H. Tulloch, M. S. Fortier, A. L. Pipe and R. D. Reid (2011). "Patterns of motivation and ongoing exercise activity in cardiac rehabilitation settings: a 24-month exploration from the TEACH Study." Annals of Behavioral Medicine **42**(1): 55-63.

Taylor, R. S., A. Brown, S. Ebrahim, J. Jolliffe, H. Noorani, K. Rees, B. Skidmore, J. A. Stone, D. R. Thompson and N. Oldridge (2004). "Exercise-based rehabilitation for patients with coronary heart disease: systematic review and meta-analysis of randomized controlled trials." American Journal of Medicine **116**(10): 682-692.

Thaler, R. H. and C. R. Sunstein (2008). Nudge: Improving decisions about health, wealth and happiness. New Haven, Yale University Press.

Troiano, R. P., D. Berrigan, K. W. Dodd, L. C. Masse, T. Tilert and M. McDowell (2008). "Physical activity in the United States measured by accelerometer." Med Sci Sports Exerc **40**(1): 181-188.

Tuckett, A. G. (2005). "Applying thematic analysis theory to practice: A researcher's experience." Contemporary Nurse **19**(1-2): 75-87.

Volpp, K. G., D. A. Asch, R. Galvin and G. Loewenstein (2011). "Redesigning employee health incentives--lessons from behavioral economics." NEJM **365**(5): 388-390.

Volpp, K. G., D. A. Asch, R. Galvin and G. Loewenstein (2011). "Redesigning employee health incentives--lessons from behavioral economics." New England Journal of Medicine **365**(5): 388-390.

Volpp, K. G. and R. Galvin (2014). "Reward-based incentives for smoking cessation: how a carrot became a stick." JAMA **311**(9): 909-910.

Wall, J., C. Ni Mhurchu, T. Blakely, A. Rodgers and J. Wilton (2006). "Effectiveness of monetary incentives in modifying dietary behavior: A review of randomized, controlled trials." Nutr Rev **64**(12): 518-531.

WHO (2014). Global Status Report on Non-Communicable Diseases.

Wilson, P., W. Rodgers, S. Fraser and T. Murrery (2004). "The relationship between exercise regulations and motivational consequences." Research Quarterly for Exercise and Sport **75**: 10.

Wilson, P. M., W. M. Rodgers, C. C. Loitz and G. Scime (2006). "'It's Who I Am...Really!' The Importance of Integrated Regulation in Exercise Contexts." J Appl Biobehavi Res **11**(2): 79-104.

Wing, R. R., R. W. Jeffery, N. Pronk and W. L. Hellerstedt (1996). "Effects of a personal trainer and financial incentives on exercise adherence in overweight women in a behavioral weight loss program." Obes Res **4**(5): 457-462.

Woodgate, J. and L. R. Brawley (2008). "Use of an efficacy-enhancing message to influence the self-regulatory efficacy of cardiac rehabilitation participants: a field experiment." Rehabilitation Psychology **53**(2): 153-161.

Woodgate, J., L. R. Brawley and Z. J. Weston (2005). "Maintenance Cardiac Rehabilitation Exercise Adherence: Effects of Task and Self-Regulatory Self-Efficacy." J Appl Soc Psychol **35**(1): 183-197.

Yu, C. M., C. P. Lau, J. Chau, S. McGhee, S. L. Kong, B. M. Cheung and L. S. Li (2004). "A short course of cardiac rehabilitation program is highly cost effective in improving long-term quality of life in patients with recent myocardial infarction or percutaneous coronary intervention." Archives of Physical Medicine & Rehabilitation **85**(12): 1915-1922.

Zullo, M. D., M. A. Dolansky and L. W. Jackson (2010). "Cardiac rehabilitation, health behaviors, and body mass index post-myocardial infarction." J Cardiopulm Rehabil **30**(1): 28-34.

Appendices

Appendix A. Medline search strategy.

[Concept 1: Population - All Adult]

exp Adult/

adult*.mp.

employee*.mp.

Men/

Women/

or/2-6

[Concept 2: Financial Elements]

exp Reward/

((award* or reward* or incentiv* or payment*) adj4 (cash or money or monies or monetary or financ* or economic* or fiscal or re-imbusement* or reinforcement* or tangible* or lump sum* or material* or individual* or external or personal or target* or direct* or intervention* or program* or scheme*)).tw.

token econom*.tw.

((deposit* or commitment*) and contract*).tw.

(pre-commitment* or precommitment* or commitment device*).tw.

(variable reinforcement* or reinforcement scheme*).tw.

(pay* adj2 perform*).tw.

((condition* or contingen*) adj3 (cash or mone* or pay* or financ*)).tw.

((behaviour* or behaviour*) and economic*).tw.

((competition* or contest* or raffle* or lott* or prize* or award*) adj4 (cash or money or monies or monetary or financ* or economic* or tangible* or lump sum* or material* or individual* or external or personal or target* or direct* or intervention*)).tw.

("in-kind" or "in kind" or voucher* or coupon* or gift* or consumer good*) adj4 (cash or money or monies or monetary or financ* or economic* or tangible* or lump sum* or material* or individual* or external or personal or target* or direct* or intervention*)).tw.

Financial Support/

((subsid* or grant*) adj5 (physical* activ* or exercise)).tw.

((economic* or financial or mone* or cash) adj4 (assist* or support* or supplement* or transfer*)).tw.

(tax adj2 (credit* or rebate*)).tw.

exp Employee Incentive Plans/

Health Benefit Plans, Employee/ and (decrease* or deduct* or saving* or discount* or reduc* or exclusion* or percent* or proportion*).tw.

Health Facilities/ and (provi* or access or free or offer* or suppl* or opportuni* or redeem* or condition* or contingent* or give* or gift*).tw.

(employe* adj4 (incentive* or rebate* or remuneration* or bonus* or reimburse*)).tw.

((health insurance or insurance premium* or insurance benefit*) adj4 (decrease* or deduct* or saving* or discount* or reduc* or exclusion* or percent* or proportion* or additional or added or enhance* or increase*)).tw.

((resource* or access* or entry or entrance or cost* or price) adj4 (free or reduc* or discount* or deduct*)).tw.

((bonus* or rebate* or credit* or compensat* or honorari* or reimburse* or remunerat* or stipend*) adj5 (physical* activ* or exercise)).tw.

((health facilit* or gym* or trainer* or member*) adj4 (provi* or access or free or offer* or suppl* or opportuni* or redeem* or condition* or contingent* or give* or gift*)).tw.

or/9-31

[Concept 3: Physical Activity Elements]

exp Exercise/

exp Exercise Therapy/

exp "Physical Education and Training"/

Physical Conditioning, Human/

exp Sports/

exp Recreation/

Yoga/

Fitness Center/

exercise*.tw.

(physical* adj3 activ*).tw.

(physical inactivity or physically inactive or sedentary).tw.

or/34-44

[Concept 4: Measurements]

Physical Fitness/

Physical Endurance/

Actigraphy/

((subjective* or survey* or questionnaire* or self-report* or objective* or pedometer* or acceleromet* or actigraph* or heart rate or GPS or track* or monitor* or adherence or compliance or participation or attend* or increas*) adj4 (physical* activ* or exercise* or fitness*)).tw.

(fitness or aerobic capacity or functional capacity or exercise capacity or endurance).tw.

((physical* activ* or exercise or aerobic) adj3 (bout* or minute* or hour* or day*)).tw.

exp Health Promotion/ and (physical* activ* or exercise*).tw.

exp Health Promotion/ and (physical* inactiv* or sedentary).tw.

Occupational Health Services/ and (physical* activ* or exercise* or physical* inactiv* or sedentary).tw.

Health Behaviour/ and (physical* activ* or exercise*).tw.

Health Behaviour/ and (physical* inactiv* or sedentary).tw.

Behaviour Modification/ and (physical* activ* or exercise*).tw.

Behaviour Modification/ and (physical* inactiv* or sedentary).tw.

Motivation/ and (physical* activ* or exercise*).tw.

Motivation/ and (physical* inactiv* or sedentary).tw.

Patient Compliance/
Program Evaluation/
Treatment Outcome/
exp "Body Weights and Measures"/
Weight Loss/
exp Obesity/
(BMI or body mass index or waist circumferenc* or body fat or adipos*).tw.
(weight adj3 (loss or reduc* or decreas* or maintain* or maintenanc* or
sustain*)).tw.
Sedentary Lifestyle/
or/47-70
and/7,32,45,71

Appendix B. List of electronic databases searched (records retrieved; date searched)

Medical

Medline ($n=931$; June 12, 2012) and re-run (Limited to 2012/13: $n=93$; January 31, 2013)

Embase ($n=2,282$; June 8, 2012)

PyschInfo ($n=1,278$, June 11, 2012)

All EBM ($n=833$, June 11, 2012)

HealthSTAR ($n=823$, June 11, 2012)

Scopus ($n=426$; June 6, 2012)

Social Sciences Abstracts ($n=547$; June 6, 2012)

Web of knowledge/science ($n=1,514$; June 6, 2012)

Other (physical therapy, business, psychology, rehabilitation sciences, physical education)

CINAHL ($n=904$; June 8, 2012)

Econlit ($n=312$; June 6, 2012)

Psycharticles ($n=53$; June 6, 2012)

Ageline ($n=103$; June 6, 2012)

Allied and complementary medicine ($n=817$; June 6, 2012)

Physical Education Index ($n=449$; June 6, 2012)

SPORTdiscuss ($n=93$; June 6, 2012)

Appendix C. List of experts consulted (email replies indicated)

- 1) Adam Oliver
- 2) Eric A. Finkelstein
- 3) Kerry Courneya (reply)
- 4) Robert W. Jeffery
- 5) Gary Charness & Uri Gneezy
- 6) Grace O'Malley (reply)
- 7) Jean Adams (reply)
- 8) Eleni Mantzari (reply)

Appendix D. Eligibility checklist.

Author (first only):

Year:

Journal Citation (Title/Journal/Volume/Page):

Reviewer: M. Mitchell J. Lacombe

Inclusion Criteria:

Yes	No	TYPE OF STUDY
<input type="checkbox"/>	<input type="checkbox"/>	Described as a randomized controlled trial Controlled study with baseline and post-intervention measures.
<input type="checkbox"/>	<input type="checkbox"/>	
YES	NO	TYPE OF INTERVENTION
<input type="checkbox"/>	<input type="checkbox"/>	Individual-level financial incentive (excluding group-level incentives e.g., community grant, of little or incentives of no monetary value e.g., sticker, certificate) <u>contingent</u> on achieving a pre-specified physical activity behaviour or fitness outcome.
YES	NO	TYPE OF OUTCOME (<i>one of the following must be YES, check all that apply</i>)
<input type="checkbox"/>	<input type="checkbox"/>	Aerobic fitness (e.g., VO_{2pred} , 6-minute walk test, etc.)
<input type="checkbox"/>	<input type="checkbox"/>	Objectively measured physical (in)activity (e.g., accelerometer, pedometer, etc.)
<input type="checkbox"/>	<input type="checkbox"/>	Subjectively measured physical (in)activity (e.g., self-report, class attendance, etc.)
YES	NO	SUBJECT CHARACTERISTICS
<input type="checkbox"/>	<input type="checkbox"/>	Adult (18yrs and older)

Exclusion Criteria:

YES	REASON FOR EXCLUSION (excluded if at least 1 YES)
<input type="checkbox"/>	Type of study: meta-analyses, systematic reviews, published letters, abstract only, comments, editorials, qualitative studies, case-series, case reports or non-peer reviewed publications (e.g., dissertations)
<input type="checkbox"/>	Other Reason: _____

Final Eligibility:

- Included (if 'yes' is checked for each inclusion category & no exclusion criteria are checked)
- Excluded (if at least 1 inclusion criteria is 'no' and/or any exclusion criteria are checked)
- Not sure: Why? _____
- Include in general literature ONLY (e.g., for current health incentive information)

Appendix E. Characteristics of included studies.

Author, Year, Country	Study effect, study quality	Participants	Intervention duration (follow-up)	Incentive intervention^a (by group)	Incentive contingency	Outcome(s)	Main finding(s)
<i>Epstein, 1980, U.S.</i>	Positive, Weak	n=15 Age: "University students" % female: 100	5 weeks	1) \$3 deposit for a max 1 in 7 chance to win \$21 (max incentive = \$4.2/wk). 2) \$5 deposit to be earned back.	1) Earn lotto token each wk if 4 out of 5 exercise sessions attended. 2) \$1 returned each wk if 4 out of 5 sessions exercise attended.	Aerobic class attendance, 12-min fitness test	Incentive groups (chance, assured) had better aerobic class attendance while controls did not; rate of fitness improvement greatest for assured group.
<i>Noland, 1989, U.S.</i>	Positive, Weak	n=27 Age: "Adults" % female: 64	18 weeks	Tokens exchanged for clothing, special dinner/food, champagne, money, time alone, going to movies.	Weekly self-reported (diary) exercise prescription completion.	YMCA cycle protocol (modified submaximal fitness test)	Incentive group fitness improved over time, while controls did not. Effect seen for previously sedentary but not previously active.
<i>Gomel, 1993, U.S.</i>	Null, Strong	n=177 Age: "Adults"	24 weeks (52 weeks)	Incentive mix	a) Lottery draw entries	Standardized 7-min.	Significant increase in

		% female: 16 % married: 61 Employment: 100% full time		including: a) 1 in 24 chance to win 2 \$40 vouchers. b) \$40 voucher. c) 1 in 4 chance of winning \$1000 group prize.	contingent on self-reporting changing at least one health behaviour each wk. (incentive for exercise self-regulatory behaviour). b) \$40 for meeting 3 mth goal. c) One \$1000 prize for group outcome success at 6 mths.	submaximal fitness test.	aerobic capacity for all groups (unclear if incentive group increased more); No significant differences in aerobic capacity between groups at 12 mths.
<i>Wing, 1996, U.S.</i>	Null, Moderate	n=37 Age (mean) years: 43.9-45.1 (SD 7.2-5.9) % female: 100 Co-morbidities: 100% overweight BMI (mean): 30.7-31.8 (SD 3.1-3.8)	24 weeks	a) 1 in 21 chance for weekly \$50 draw. b) 1 in 21 grand draw at end of 24 wks for \$2000 (probabilities improved as people dropped out).	Lottery entries contingent on exercise session attendance.	Walking session attendance.	Incentive group attendance not significantly higher than control (difference approached significance in last 5 wks of intervention).
<i>Courneya,</i>	Positive,	n=200	4 weeks	Free 1 mth.	Contingent on	Gym	Mean gym

<i>1997, Canada</i>	Strong	Age (mean) years: 36 (SD 9) % female: 31.5 Employment: Mix of full-time, part-time, retired, unemployed. Co-morbidities: 100% overweight BMI (mean): 30.7-31.8 (SD 3.1-3.8)		gym membership (\$53)	12 visits in 1 mth.	attendance.	attendance higher in incentive group. Percent of participants achieving 12 visits increased 6-fold in incentive group compared to baseline.
<i>Jeffery, 1998, U.S.</i>	Positive, Moderate	n=78 Age (mean) years: 41-42.6 (SEM 1.3-1.4) % female: 79-86 % married: 52-68% Education: 65-81% college educated Employment=Mix of full-time, part-time, retired, unemployed. Co-morbidities: 100% overweight BMI (mean): 31.4-31.5 (SEM 0.3-0.4)	72 weeks	Max. \$491 available over 18 mth.	\$1 for each of first 25 walks, \$1.5 for next 50 walks, \$2 for next 50 walks, \$3 per walk until end of program.	Walk/run session attendance, Paffenbarger Physical Activity Questionnaire (PAQ)	Incentive increased supervised exercise attendance but not overall exercise level (PAQ).

<i>Jeffery, 1999, U.S.</i>	Null, Moderate	n=395 Age (mean) years: 38.5-38.8 (SEM 1.3-1.4) % female: 77.7-79.3 Ethnicity: 92-93% Caucasian Co-morbidities: 100% overweight BMI (mean): 26.1-27.5	156 weeks	1 in 10 chance for \$100 lottery each mth.	Contingent on returning post-card with answers about diet, exercise, weight included (incentive for exercise self-regulatory behaviour).	Adapted physical activity questionnaire—reported in metabolic equivalents.	Postcard return/news. readership significantly higher in education+ incentive group vs. education only. Reported exercise decreased similarly in the education and education+ incentive groups but not to statistically significant levels.
<i>Finkelstein, 2008, U.S.</i>	Positive, Moderate	n=70 Age (mean) years: 59.4-61.2 % female: 73.3-76.2 Education: 70-85.7% college educated Ethnicity: 94.3-95.2% Caucasian Employment: Mix of full-time, part-	4 weeks	a) Initial \$50 for study participation. b) Additional \$0, \$10, \$15 and \$25 each wk depending on level of activity (more aerobic	Incentive contingent on number of aerobic minutes reported on mailed activity log/pedometer.	Average aerobic minutes per wk.	Incentives increased exercise among sedentary older adults. Lower education/ income adults and those working fewer hours were more likely to respond.

		time, retired, unemployed. Income: 38.9-42.9% >\$50,000 2008 U.S. dollars. Physical activity history: 100% sedentary.		minutes = larger incentive).			
<i>Charness, 2009a, U.S.</i>	Positive, Moderate	n=120 Age (mean) years: 18-23 % female: Mix Education: 100% attending college Employment: 100% college students Physical activity history: Mix of previously active/inactive.	1) 1 week 2) 5 weeks (7 weeks)	1) \$25 2) \$125	1) Incentive for attending gym at least once in 1 wk. 2) As group (1) but also \$100 to attend gym 8 more times in the next 4 wks.	Gym attendance.	Post-intervention gym attendance highest for high-incentive group. Drop in attendance post-intervention in previously active group.
<i>Charness, 2009b, U.S.</i>	Positive, Moderate	n=168 Age (mean) years: 18-21 % female: Mix Education: 100% attending college. Employment: 100% college students. Physical activity	1) 4 weeks 2) 4 weeks (16 weeks)	1) \$175 2) \$175	1) Incentive for attending gym at least once in 1 mth. 2) Incentive for attending gym at least 8 times in 1 mth.	Gym attendance.	Post-intervention gym attendance higher among 8-times incentive group vs. 1-time incentive and control groups. Drop in

		history: Mix of previously active/inactive. BMI (mean): 21.7-23.2					attendance post-intervention in previously active.
<i>Daryanto, 2010, U.K.</i>	Positive (n/a), Weak	n=50 Age (mean) years: 23.05 (SD 2.73) % female: 61.4 Physical activity history: 83.6% already exercising at least twice per wk.	4 weeks	€10 reimbursed from €45 gym membership fee.	Re-imbursement contingent on exercising at gym 8 times (for 30 min.) in 1 mth.	Gym attendance, time/intensity of exercise.	Minutes and intensity of exercise greater in the incentive condition ('promotion fit') vs. controls ('promotion nonfit'). Frequency of exercise not significantly different.

^aIncentive quantities listed as reported in included studies (not inflation adjusted, converted to dollars/pound per week); 1) and 2) denote incentives for treatment groups; a), b) and c) denote different components of mixed incentive schemes; ES, effect size; Max, maximum; Wk, week; Min, minute; Mth, month; BMI, body mass index; SD, standard deviation; SEM, standard error of the mean; Vs, versus.

Appendix F: The complete Health Incentive Program Questionnaire.

The Health Incentive Program Questionnaire (HIP-Q)

It may be that a financial health incentive, like getting paid to exercise, could help you start and/or maintain an exercise program. You could be paid in cash, or with healthy vouchers, to do your exercise. You could earn grocery or drug store vouchers, gym discounts, magazine subscriptions or even make charitable donations for exercising regularly! The answers you give in this questionnaire are very important and will help us design a health incentive program ***just for you!***

***Start on the next page!**

Your opinion

1. For each **pair of words** below, check the box that best represents how you feel about being paid to exercise.

“For me, getting paid cash or health-related vouchers to exercise **would be...**”

<u>Good</u>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<u>Bad</u>
	Strongly Agree	Agree	Neutral	Agree	Strongly Agree	

<u>Not fun</u>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<u>Fun</u>
	Strongly Agree	Agree	Neutral	Agree	Strongly Agree	

<u>Effective</u>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<u>Not effective</u>
	Strongly Agree	Agree	Neutral	Agree	Strongly Agree	

<u>Silly</u>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<u>Sensible</u>
	Strongly Agree	Agree	Neutral	Agree	Strongly Agree	

<u>Useful</u>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<u>Useless</u>
	Strongly Agree	Agree	Neutral	Agree	Strongly Agree	

<u>Necessary</u>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<u>Unnecessary</u>
	Strongly Agree	Agree	Neutral	Agree	Strongly Agree	

Question 1 continued...

“For me, getting paid cash or health-related vouchers to exercise **would make me feel...**”

<u>Guilty</u>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<u>Not guilty</u>
	Strongly Agree	Agree	Neutral	Agree	Strongly Agree	

2. In general, how likely would you be to participate in an incentive program that paid you \$40 a month for exercising 15 minutes a day, 3 days a week?

Please circle one (1) option.

Very unlikely	Unlikely	Neutral	Likely	Very likely
1	2	3	4	5

*Incentive programs can be designed in different ways. The next questions asks which design ‘features’ would make you more likely to participate in an incentive program that paid you **\$40 a month for exercising 15 minutes a day, 3 days a week.***

3. “I would be more likely to participate in an incentive program if incentives were...”

Please check one (1) of the boxes.

- Paid for by the government
- Paid for by a company I trust
- Who pays for the incentive doesn’t matter to me
- I would NOT participate in an incentive program

4. “I would be more likely to participate in an incentive program if I was...” Please check one (1) of the boxes.

- Paid cash
- Paid with vouchers, like grocery store or gym membership vouchers
- Able to donate my incentive to my favourite charity
- The ‘type’ of incentive doesn’t matter to me
- I would NOT participate in an incentive program

5. **“I would be more likely to participate in an incentive program if I was paid to...”**
 Please check one (1) of the boxes.

- Do certain behaviours, like exercise regularly (15 minutes a day, 3 days a week)
- Achieve certain outcomes, like improve my fitness (the amount of time I can exercise)
- The incentive ‘target’ doesn’t matter to me
- I would NOT participate in an incentive program

6. **How likely would you be to wager your own money in an incentive program?** For example, you get \$40 of your own money back if you meet the goal of exercising 15 minutes a day, 3 days a week, for a month. If you do not meet the goal, your \$40 goes to other program participants.

Please circle one (1) option below.

Very unlikely	Unlikely	Neutral	Likely	Very likely
1	2	3	4	5

7. **How likely would you be to wager your own money if it meant that you could double your money?** For example, if you wagered \$40 of your own money then you would receive \$80 back if you exercised 15 minutes a day, 3 days a week, for a month - called ‘double or nothing’. If you do not meet the goal, your \$40 goes to other program participants.

Please circle one (1) option below.

Very unlikely	Unlikely	Neutral	Likely	Very likely
1	2	3	4	5

8. What is the **MINIMUM** amount you would need to be paid in cash or vouchers, if any, **each month** to motivate you to exercise for 15 minutes a day, 3 days a week? Please circle one (1) monthly dollar amount.

\$0	\$10	\$20	\$30	\$40	\$50	\$60	\$70	\$80 or more
-----	------	------	------	------	------	------	------	--------------

If you were being paid to exercise for 15 minutes a day, 3 days a week, for a month, which incentive program 'feature' below would you prefer?

9. a) The '**daily**' or the '**lump sum**' incentive? Please check one (1) of the boxes.

- Get paid \$3.33 right away on the days that I do my exercise (can earn up to \$40 in a month)
- Wait until the end of the month to get paid a 'lump sum' of up to \$40 (get paid at the end of the month for the days you exercised)
- I don't have a preference
- I would NOT participate in an incentive program

b) The '**daily**' or the '**lump sum**' incentive? Please check one (1) of the boxes.

- Get paid \$3.33 right away on the days that I do my exercise (can earn up to \$40 in the month)
- Wait until the end of the month to get paid a 'lump sum' of up to **\$30 (a little less)**
- I don't have a preference
- I would NOT participate in an incentive program

c) The '**daily**' or the '**lump sum**' incentive? Please check one (1) of the boxes.

- Get paid \$3.33 right away on the days that I do my exercise (can earn up to \$40 in the month)
- Wait until the end of the month to get paid a 'lump sum' of up to **\$50 (a little more)**
- I don't have a preference
- I would NOT participate in an incentive program

If you were being paid to exercise for 15 minutes a day, 3 days a week, for a month, which incentive program 'feature' below would you prefer?

10. The 'guaranteed' or the 'lottery' incentive? Please check one (1) of the boxes.

- Get paid \$40 for sure – 'guaranteed' incentive
- Have a 1 in 10 chance of winning \$300 – 'lottery' incentive
- I don't have a preference
- I would NOT participate in an incentive program

11. a) The 'individual' or the 'group' incentive? Please check one (1) of the boxes.

- Get paid \$40 if I exercise 15 minutes a day, 3 days a week, for a month
- Get paid \$40 if at least half the people in my 'group' (group from work or in your exercise class, for example) exercise 15 minutes a day, 3 days a week, for a month
- I don't have a preference
- I would NOT participate in an incentive program

b) The 'individual' or the 'group' incentive? Please check one (1) of the boxes.

- Get paid \$40 if I exercise 15 minutes a day, 3 days a week, for a month
- Get paid **\$50 (a little more)** if at least half the people in my 'group' exercise 15 minutes a day, 3 days a week, for a month
- I don't have a preference
- I would NOT participate in an incentive program

***Go to question 12 on the next page.**

12. **Please indicate how you would prefer to receive your incentive, if at all.** Please check one (1) of the following boxes.

- In person pick-up (you go to a specific location to pick up your payment)
- By mail (received within 5 to 7 days)
- By courier (received within 1 to 2 days)
- By email transfer through your internet banking (received immediately)
- Using a special website, like the AIRMILES website (received immediately)
- Using your 'smart phone' or 'tablet' (received immediately)
- I don't have a preference
- I would NOT participate in an incentive program.

13. **How long, if at all, would you want to participate in an incentive program?** Please check one (1) of the following boxes.

- 1-3 months
- 4-6 months
- 7-12 months
- More than 1 year
- I don't have a preference
- I would not participate in an incentive program

***Go to question 14 on the next page.**

14. As a member of an incentive program, what vouchers would you prefer? Keep in mind that all vouchers would have equal monetary value.

<p>Check the box <input checked="" type="checkbox"/> next to your THREE FAVOURITE voucher options below:</p>	<p>Next to the THREE checked <input checked="" type="checkbox"/> boxes ONLY, print the name of your favourite shop, gym, store, magazine, charity, etc.:</p>
<p>Food and beverage</p> <ul style="list-style-type: none"> <input type="checkbox"/> Food/grocery store <input type="checkbox"/> Coffee/tea shop <input type="checkbox"/> Restaurant 	<p>_____</p> <p>_____</p> <p>_____</p>
<p>Exercise-related</p> <ul style="list-style-type: none"> <input type="checkbox"/> Gym/health club <input type="checkbox"/> Running shoes <input type="checkbox"/> Other sports equipment 	<p>_____</p> <p>_____</p> <p>_____</p>
<p>Transportation and travel</p> <ul style="list-style-type: none"> <input type="checkbox"/> Public transit (for the bus, train) <input type="checkbox"/> Hospital parking (for appointments) <input type="checkbox"/> Travel points (AIRMILES, Aeroplan) 	<p>_____</p> <p>_____</p> <p>_____</p>
<p>Entertainment</p> <ul style="list-style-type: none"> <input type="checkbox"/> Movie passes 	<p>_____</p>
<p>Health education resources</p> <ul style="list-style-type: none"> <input type="checkbox"/> Magazine subscription (cooking, health) 	<p>_____</p>
<p>Retail</p> <ul style="list-style-type: none"> <input type="checkbox"/> Department store (Walmart, Costco) <input type="checkbox"/> Drug store (Shoppers Drug Mart) <input type="checkbox"/> On-line store (Ebay, Amazon) <input type="checkbox"/> Other store 	<p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p>
<p>Donation to charity</p> <ul style="list-style-type: none"> <input type="checkbox"/> My favorite charities 	<p>_____</p> <p>_____</p> <p>_____</p>
<p>Other</p> <ul style="list-style-type: none"> <input type="checkbox"/> Other 	<p>_____</p> <p>_____</p> <p>_____</p>

Thank you for completing the survey!

Appendix G: Incentive program design feature attributes.

Type	Quantity	Probability	Timing	Participant investment	Information Disclosure	Dispensing type	Type of assessment
Voucher	Indexed, \$2 per day exercise self-monitored	Assured	Assessed weekly; points accrued immediately; reward mailed and received within 5 days	None	Factual – ‘You completed X% of your exercises this week.’	Aggregative (rewards could not be lost, or ‘reset’)	Objective, direct, behavioral assessment of exercise self-monitoring

Appendix H: Ten suggestions for improving the online diary and 'Reward Store' user experience.

- 1) Have login page 'remember' participant email address;
- 2) Restrict access to other (non-intervention) point earning opportunities as these may confuse participants;
- 3) Add 'No Exercise Completed' option to dropdown list of possible exercise activities;
- 4) Resistance training 'checkbox' should *not* be pre-selected (ticked) 'Yes', so not to deprive participants of the satisfaction of tracking the behaviour;
- 5) Automatically send e-mail to participant if data not submitted by weekly (e.g., Tuesday midnight) deadline (or send the day before deadline to prompt timely data entry) including information about e.g., rewards not earned (loss aversion), submission rate amongst rest of program participants (social norms), etc.;
- 6) Extend weekly deadline to Tuesday at midnight (from Sunday at midnight) to make it easier for participants to submit exercise information 'on time'.
- 7) Following exercise diary submission, immediate prompt (e.g., once weekly) to redeem points for rewards should be included;
- 8) Incorporate 'One Click' reward selection option to reduce effort required to redeem points for vouchers. Alternatively, design program so preferred reward sent automatically upon diary submission, point threshold achievement;
- 9) Allow participants to enter the number of vouchers they would like to redeem for, instead of requiring them to search and select the same voucher multiple times.
- 10) Consider the development of a specialized mobile phone 'application' to further reduce the effort ('friction') required to log-into and self-monitor exercise.