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The role of motivation and the regulation of eating on the physical and psychological health of patients with cardiovascular disease

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Abstract

This study tested a longitudinal motivation model for healthy eating in patients with cardiovascular disease, using self-determination and social-cognitive theories. A total of 513 patients completed measures of eating habits, global motivation, motivation for eating, self-efficacy for eating and life satisfaction, immediately after a major cardiac incident and at three times during a year (e.g. 2008–2009). Physiological indicators were measured to examine how they predicted the participants' physical health. Results found participants with self-determined motivation were more likely to develop a sense of self-efficacy towards eating and a healthy diet, which had beneficial effects on their physical health and life satisfaction.

Keywords

motivation, patients with cardiovascular disease, regulation of eating

Cardiovascular diseases (CVDs) represent a leading cause of death in Canada (Statistic Canada, 2008) and are responsible for about one third of all global deaths. Unhealthy diets have been identified as a major behavioural risk factor for CVD. Individuals who follow unhealthy diets (e.g. rich in saturated fats, salt and refined carbohydrates, and low in fruits and vegetables) are more likely to suffer from hypertension, hyperglycaemia, a high level of lipids and obesity, which further increases their risk of developing CVD (World Health Organization (WHO), 2013). Because of these risk factors, proper regulation of a healthy diet is an essential component in the recovery process for patients with CVD.

Even though these individuals should adopt healthier eating habits, the regulation of eating remains a complex challenge for many. Following a healthy diet on a regular basis also requires continuous efforts to resist temptations and delay gratification (Pelletier et al., 2004). Despite these difficulties, some individuals manage to improve the regulation of their eating behaviours by overcoming obstacles, temptations, impulses and habits that compromise their long-term goals (Hagger et al., 2009).

Several theories of health behaviour change have emerged in an attempt to identify the factors that explain and predict the adoption of

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healthy eating behaviours. Self-determination theory (SDT; Deci and Ryan, 1985) and social-cognitive theory (SCT; Bandura, 1997) have been applied to improve understanding of how individuals initiate and maintain their health behaviours. In order to examine the regulation of eating in patients with CVD, some key constructs from these two theories were incorporated into this study. An overview of SDT and SCT will be discussed in the next sections.

Self-Determination Theory

SDT (Deci and Ryan, 2008) is a theory of motivation that explains the mechanisms underlying the maintenance of behaviours over time. According to SDT, there are three types of motivation (amotivation, extrinsic and intrinsic) that can be divided into behavioural regulations that explain why people engage in certain behaviours. These behavioural regulations can be placed along a continuum from non-self-determined regulations (amotivation, external and introjected) to the more self-determined regulations (identified, integrated and intrinsic) (Deci and Ryan, 1985, 2008). At the non-self-determined end of the continuum, individuals believe that external forces govern their behaviours. As an individual moves towards the self-determined end of the continuum, they voluntarily engage in activities because they give them a sense of pleasure and satisfaction. Once individuals are engaging in behaviours for these reasons, they experience quality motivation, which leads to positive behavioural and psychological outcomes (Vallerand et al., 2008).

In the health domain, many studies show that self-determined motivation is associated with beneficial consequences for the physical and psychological health of individuals such as weight loss (Williams et al., 1996), physical activity (Teixeira et al., 2012), healthy eating (Pelletier and Dion, 2007; Pelletier et al., 2004), glycemic control (Williams et al., 2004) and well-being (Deci and Ryan, 2008). Despite the evidence that self-determined motivation leads to positive outcomes, humans experience variations in motivation quality in the different aspects of their lives. For example, someone may experience high-quality motivation for one activity, and low quality for another, which is explained through the hierarchical model of intrinsic and extrinsic motivation (Vallerand, 1997). According to this model, an individual's motivation for a specific behaviour will be influenced by factors that are relevant to the context of that behaviour and an individual's general motivation. Using the regulation of eating as an example, an individual's motivation towards healthy eating is influenced by the context in which they are trying to eat healthily and their general motivation, which is relatively constant.

SDT and the regulation of eating. Many studies have combined SDT and health in order to understand health behaviour change in individuals (Ryan et al., 2008), including the regulation of eating behaviour. Results have shown that self-determined motivation is positively associated with an objective approach to healthy eating and the consumption of healthy foods, while non-self-determined motivation is associated with an avoidance approach to unhealthy eating and the consumption of unhealthy foods (e.g. Otis and Pelletier, 2008; Teixeira et al., 2011). Self-determined motivation has also been associated with the quality of food consumed, while non-self-determined motivation has been associated with the amount of food consumed by individuals (Pelletier and Dion, 2007; Pelletier et al., 2004). Pelletier and Dion (2007) also demonstrated that the adoption of healthy eating behaviours is associated with better psychological health (e.g. lower symptoms of depression, greater life satisfaction and high self-esteem), compared to the adoption of dysfunctional eating behaviours. In terms of physical health, Leong et al. (2012) demonstrated that the association between self-determined and non-self-determined motivation, and body mass index (BMI) was partially mediated by eating habits in middle-aged women. In individuals at risk for CVD, Pelletier et al. (2004) showed that general motivation predicted motivation for eating behaviours at a 13-week follow-up. The motivation for eating behaviours at 13 weeks negatively predicted the consumption of calories from fat and saturated fats, which then predicted

improved physiological indicators in these individuals (e.g. weight, levels of low-density lipoprotein (LDL) and high-density lipoprotein (HDL) cholesterol and triglycerides).

In sum, SDT has provided a solid framework for understanding health. The motives behind the individuals' behaviours can provide insight about the success or failure of the maintenance of these behaviours over time. With respect to the regulation of eating, the more individuals are self-determined towards the regulation of their eating habits, the more likely they are to adopt a healthy diet and achieve physical and psychological health.

Social-Cognitive Theory

SCT (Bandura, 1997) postulates that behaviour change is possible when an individual has a sense of personal control over their actions (Connor and Norman, 1996). An individual who feels effective towards a specific behaviour is more likely to engage in the behaviour. Self-efficacy, one of the basic constructs of SCT, is used to predict behaviour change since it reflects an individual's perceptions of their abilities to perform a specific task (DeVellis and DeVellis, 2000). According to Bandura (1997), an individual's perceived self-efficacy directly influences their commitment to a behaviour as they tend to engage in activities for which they consider themselves effective and avoid activities for which they consider themselves ineffective.

Many studies have measured the perception of self-efficacy of individuals to predict health behaviour change and maintenance (Schwarzer and Luszczynska, 2005, for a review). For example, self-efficacy has been shown to be an important predictor of smoking and alcohol cessation, weight control and exercise behaviours. In regard to eating behaviours, a prospective study by Roach et al. (2003) examined if increasing self-efficacy in young adults during a 12-week programme would promote greater weight loss. Results showed that the more self-efficacy the participants felt during the programme, the more likely they were to adopt healthier eating habits and to lose weight. Another study (Linde et al., 2006) examined the relationships between self-efficacy, weight control and weight change. They found that self-efficacy beliefs positively predicted weight control behaviours and weight change during an active treatment; however, the maintenance of these changes was not significant during the follow-up. Bernier and Avard (1986) also found that self-efficacy was a significant predictor of weight loss at 6 weeks and at 6 months in overweight woman. More interestingly, when examining different health behaviour change theories, Palmeira et al. (2007) found that theories including self-efficacy were better at predicting weight change than theories that did not. Because there is a reciprocal relationship between self-efficacy and behaviours, self-efficacy has often been interpreted as a significant determinant in the initiation and the maintenance of health behaviours (Rothman et al., 2004). More specifically, Bandura (1997) suggests that the success of behaviour increases an individual's confidence in their abilities, which then leads to the continuation of the long-term behaviour, while the failure of behaviour decreases the perception of self-efficacy, which leads to the discouragement of this behaviour.

Self-determination and social-cognitive theories

Rothman et al. (2004) have suggested that both motivation and self-efficacy play an important role in the initiation and maintenance of behaviour change. To better understand the mechanisms underlying the initiation of behaviour, two studies (Slovinec-D'Angelo et al., 2007, 2014) examined the role of motivation and self-efficacy on the regulation of exercise in patients with CVD. More specifically, these researchers examined whether self-determined motivation predicted self-efficacy, or the contrary, if self-efficacy predicted self-determined motivation, and second, what the respective roles of the two constructs were in predicting long-term behaviour change. The first study by Slovinec-D'Angelo et al. (2007) examined the role of motivation and self-efficacy on cognitive processes, specifically the patients' intentions and plans to engage in

regular physical activity. The second study (Slovinec-D'Angelo et al., 2014) examined the same two constructs, but examined the exercise behaviours of the patients during the course of 1 year. In the first study, the model that examined self-efficacy as a mediator showed a better prediction of intentions than the alternative model. The adjustments of the two models, however, were identical, suggesting that the two sequences are indeed possible (Slovinec-D'Angelo et al., 2007). The second study by Slovinec-D'Angelo et al. (2014) showed similar results. They found the model examining self-efficacy as a mediator between motivation and exercise behaviours had a better fit than the alternative model, but again, these results suggest that motivation and self-efficacy have roughly equal roles in predicting the initiation of behaviours (i.e. 6 months later). When the two constructs were compared in relation to the maintenance of behaviour, the results showed that only self-determined motivation was a significant predictor of the maintenance of long-term behaviour (12 months later). In sum, on the basis of these two studies, it seems that an individual needs to feel motivated, but also effective, towards a specific behaviour for the initiation of this behaviour to occur. The individual, however, must especially be motivated in a self-determined way so that the behaviour is maintained in the long term.

To date, no longitudinal study has been conducted on the motivation of individuals to regulate their eating behaviours, immediately after receiving a threatening diagnosis of CVD. In this study, a motivational model examining the regulation of eating behaviours of patients with CVD will be tested to examine the role of motivation and the perception of self-efficacy on their eating habits over time. Since motivation and self-efficacy may both play important roles in predicting behaviour change, both constructs will be used in the motivational model examining the regulation of eating presented below.

Objectives and hypotheses

The main objective of this study is to replicate Slovinec-D'Angelo et al. (2007, 2014) motivation models for the regulation of exercise in the context of the regulation of eating. These models examined both motivation and self-efficacy, and their relationship with exercise behaviour over time. For this study, two models will be tested. In the first, it is proposed that (1) global self-determined motivation at baseline will positively predict self-determined motivation for the regulation of healthy eating at 3 months and that (2) global non-self-determined motivation at baseline will positively predict non-self-determined motivation for the regulation of healthy eating at 3 months. In addition, it is hypothesized that (3) self-determined motivation for healthy eating at 3 months will be positively associated with self-efficacy for healthy eating at 3 months and that (4) non-self-determined motivation for the regulation of healthy eating at 3 months will be negatively associated with self-efficacy for healthy eating at 3 months. Based on previous research, adopting a healthy diet should predict positive changes in physiological indicators of patients with CVD and their life satisfaction. Therefore, after controlling physiological indicators of health, healthy eating and life satisfaction at baseline, it is proposed that (5) healthy eating at 6 months will be positively associated with reduced waist circumference, cholesterol levels and triglycerides at 12 months, and finally (6) healthy eating at 6 months will be positively associated with higher life satisfaction at 12 months. The hypothesized model for the regulation of eating is shown in Figure 1.

In the second model (the alternative model), the same constructs will be examined; however, motivation for the regulation of healthy eating at 3 months and self-efficacy for healthy eating at 3 months will be reversed. This model will be tested in order to determine whether motivation for the regulation of healthy eating at 3 months or a sense of self-efficacy is a better mediator between the variables measured at baseline and the adoption of a healthy diet at 6 months. Based on the results of the studies of Slovinec-D'Angelo et al. (2007, 2014), it is proposed that (7) the alternative model will have a worse fit than the hypothesized model.

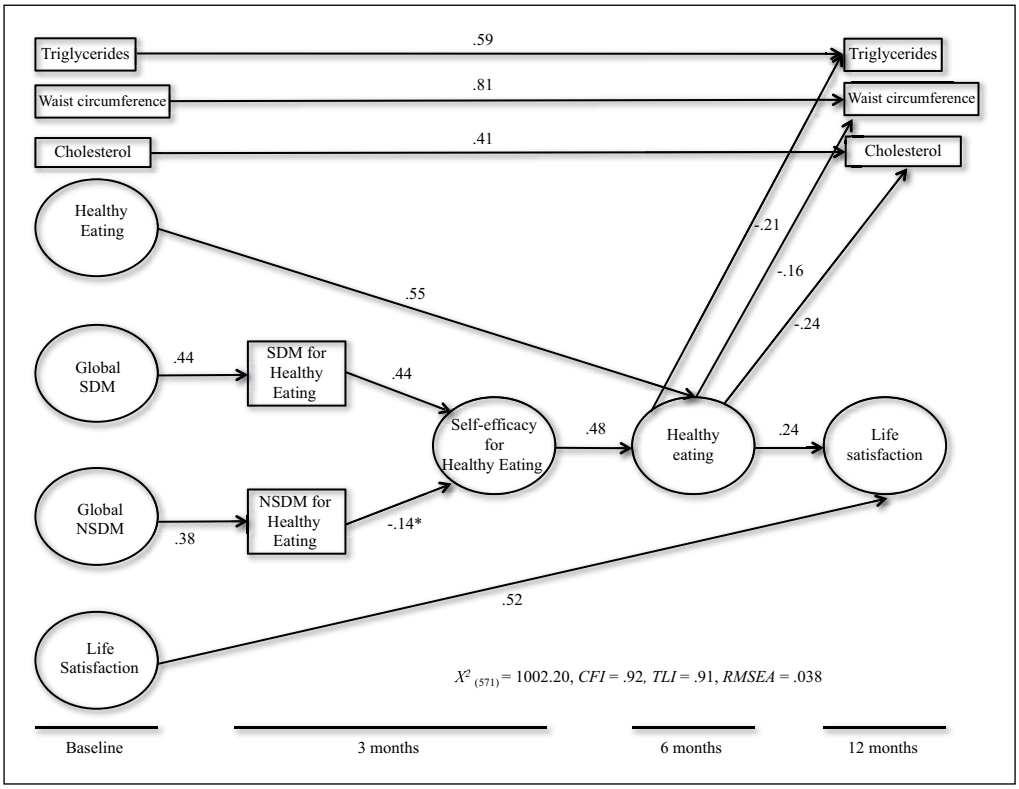

Figure 1. The hypothesized model for the regulation of eating where self-efficacy is a mediator.

Methodology

Participants

The sample included 513 patients with CVD (392 men and 121 women) aged 25–75 years ($M = 58$; standard deviation (SD) = 8.5) from the province of Québec in Canada. The sample size was determined based on the number of cardiac incidents seen at the hospital during the recruitment phase. Participants were informed about the study when they were receiving an annual coronary angiography at the Department of Medicine or they were hospitalized with a diagnosis of myocardial infarction or acute coronary syndrome at the Hospital Centre for Health and Social Services in Chicoutimi (HCHSSC), and according to their physician, they had to change eating habits to improve their health and reduce their risk of having more serious complications related to their disease. To participate in the study, patients had to be between ages 18–75 years and had to have a confirmed diagnosis of atherosclerotic CVD. Individuals who suffered from a disease affecting the prognosis of survival (e.g. neoplasia, renal failure or neuromuscular disease affecting daily activities) or a significant cognitive or psychiatric illness were not eligible to participate. The average weight of the participants at the start of the study was 80 kg (SD = 17.5 kg) and 21 percent of participants had diabetes. Looking at measures of total cholesterol and triglycerides, 26 percent of participants had problematic levels of cholesterol (>5.20 mmol/L) and 44 percent had problematic levels of triglycerides (>1.70 mmol/L). The vast majority of patients had a heart problem that was very serious

Table 1. Data collection phases and participant flow.

Measures	Time 1 (baseline)	Time 2 (3 months)	Time 3 (6 months)	Time 4 (12 months)
Physiological measures				
1. Triglycerides	X			X
2. Waist circumference	X			X
3. Cholesterol	X			X
Psychological measures				
1. Healthy eating	X		X	
2. Global motivation	X			
3. Life satisfaction	X			X
4. Motivation for the regulation of eating		X		
5. Self-efficacy for the regulation of eating		X		
Participant flow	$n = 513$	$n = 340$	$n = 295$	$n = 262$

'X' represents the measures that were completed by the participants at the different time points during the study.

(80%) and for almost half of the patients, their heart condition could create more serious problems for them in the future.

Procedure

After having obtained the consent of the participants, psychological information was collected through a series of questionnaires. Psychological measures were taken at four time points: at baseline (Time 1), immediately after receiving a diagnosis of CVD, participants completed measures of global motivation, eating habits and life satisfaction, demographic and medical history; at 3 months (Time 2), motivation and self-efficacy for the regulation of eating were measured; at 6 months (Time 3), eating habits were re-measured; and at 12 months (Time 4), life satisfaction was measured again. Physiological indicators were collected at baseline (Time 1) and at 12 months (Time 4). Data collection phases and the participant flow at each time point during the study are shown in Table 1.

Measures

Demographic information. A demographic questionnaire was administered to participants in order to obtain basic patient information and their medical and cardiovascular history.

Global motivation scale (GMS). Participants completed the French version of the GMS to measure their general self-determined motivation (Pelletier & Dion, 2007; Pelletier et al., 2004). The scale contains six subscales (with 3 items each; 9 items associated with self-determined motivation and 9 items to non-self-determined motivation) representing the different types of motivation proposed by SDT (Deci and Ryan, 1985). Participants were asked to respond to statements using a 7-point Likert scale. Internal consistency indices for intrinsic motivation, integrated, introjected, external regulation and amotivation are satisfactory ($\alpha > .70$) and acceptable for the identified regulation ($\alpha = .66$). The mean scores were calculated for each of the subscales and were used as observed variables in the model. The intrinsic, integrated and identified variables made up the self-determined global motivation latent variable and the introjected, external and non-regulation variables made up the non-self-determined latent variable.

Eating habits. The eating habits scale (Otis and Pelletier, 2008), a scale inspired by the Canadian Food Guide (Health Canada, 2011), was used to assess the participants' eating behaviours. The scale contains four items representing healthy eating (sample translated item: 'I eat fruits, vegetables and grain products, such as pasta, cereals

and legumes'). Participants were asked to report their level of agreement with each statement using a 5-point Likert scale. Factor analyses and reliability analysis support the structure of the scale (Otis and Pelletier, 2008).

Satisfaction with Life Scale. The French version of the Satisfaction with Life Scale (SWLS) (original version Diener et al., 1985) was used to measure the participants' degree of general life satisfaction. The participants were asked to respond to the five statements using a 7-point Likert scale. The internal consistency of the scale is good at baseline ($\alpha = .88$) and again at 12 months ($\alpha = .89$).

Motivation for the regulation of eating. A scale on the motivation for the regulation of eating was adapted for the purpose of this study from a scale based on personal goals developed by Sheldon and Elliot (1999). The scale consists of six items measuring all SDT forms of motivation for the regulation of eating. Participants were asked why they adopt healthier eating habits ('… As something related to my health situation compels me to do it'), using a 7-point Likert scale. For the structural model, two observed variables were created to motivation for the regulation of eating. The self-determined variable was created by taking the mean score of the intrinsic, integrated and identified regulation items; while the non-self-determined variable was created by taking the mean score of the introjected, external and non-regulation items.

Self-efficacy for the regulation of eating. Participants' self-efficacy for the regulation of their eating behaviours was measured using a scale developed by Williams et al. (1996). The original scale was developed to measure self-efficacy perceptions of individuals to adopt healthy eating habits. The scale consists of four statements (e.g. 'I feel able to commit to adopt healthier eating habits') and responses range from 1 to 7. In this study, the internal consistency of the four items was good ($a = .86$).

Physiological indicators. Physiological indicators (waist circumference, levels of total cholesterol and triglycerides) of the participants were measured using parameters and medical tests by a medical team at baseline (Time 1) and at 12 months (Time 4). Waist circumference was measured in centimetres using a tape measure. Although there are no strict guidelines for problematic waist circumferences, measurements approaching 102 cm for men and 88 cm for women are considered to be problematic (Health and Stroke Foundation, 2010). Total cholesterol and triglycerides were measured through a blood test, and the samples were taken at the same time. Patients were required to fast for 12 hours before their appointments. Total cholesterol was measured in millimoles per litre (mmol/L) where levels below 5.20 mmol/L are considered normal, levels between 5.20 and 6.20 mmol/L are borderline high, and anything above 6.20 mmol/L is high. Triglycerides were also measured in millimoles per litre where anything below 1.69 mmol/L is considered normal, anything between 1.7 and 2.25 mmol/L is borderline high, anything between 2.26 and 5.65 mmol/L is high, and anything higher than 5.65 mmol/L is very high (Miller, et al., 2011). For both total cholesterol and triglycerides, an improvement in these measures is represented by a negative relationship between Time 1 and Time 4 in the model.

Analyses and results

Analyses

First, the data were screened for univariate and multivariate normality. Then, structural equation model (SEM) analyses were performed using SPSS AMOS 20.00 (IBM, 2012) to test the model. In all testing, missing data were imputed using the stochastic regression imputation for maximum likelihood estimation. The following model fit indices were selected using Kline's (2005) recommendation: chi-square (χ^2), the comparative fix index (CFI), the Tuker–Lewis index (TLI) and the root mean square error of approximation (RMSEA). Since the hypothetical model and the alternative model were not nested, the Akaike information criterion (AIC) has also been reported (see

Kline, 2005) in order to compare the fit of both models. In the first phase, the measurement model analyses were conducted to determine whether the observed variables loaded on to their appropriate latent variables; then, two structural models were tested. The overall model fit of both models were compared using the *AIC* indices to evaluate which model had better fit.

Preliminary analyses

First, the distributions of the variables were examined and the data were cleaned to identify univariate outliers. Observations with standardized scores of ±3.29 were identified as outliers and 29 scores were recoded using the most extreme value, but still within the normal range. Next, Mahalanobis distances were calculated to identify multivariate outliers. The process identified 12 participants, and they were removed from the subsequent analyses. The variables had normal distributions; except for triglycerides (Time 1 and 4) that showed an asymptotic distribution. A log transformation was used to correct the distributions. The descriptive statistics of the model variables are shown in Table 2.

Measurement model

The model contained 7 latent variables and 34 observed variables. At baseline, there were 4 latent variables: eating habits (4 indicators), global self-determined motivation (3 indicators), global non-self-determined motivation (3 indicators) and life satisfaction (5 indicators), as well as 3 observed variables (triglycerides, total cholesterol and waist circumference). At 3 months, there was 1 latent variable (perception of self-efficacy for healthy eating with 4 indicators) and two observed variables: self-determined motivation for the regulation of eating and non-self-determined motivation for the regulation of eating. At 6 months, there was 1 latent variable: eating habits (4 indicators), and at 12 months, there was also 1 latent variable (life satisfaction with 5 indicators) and 3 observed variables (triglycerides, total cholesterol and waist circumference). The latent factors were free to correlate. The measurement model had a good fit ($\chi^2_{(497)} = 820.73$, $CFI = .94$, $TLI = .92$, $RMSEA = .04$). The results of the factor analysis supported that the observed variables loaded appropriately onto their factors.

Structural models

The results of the hypothesized model estimation support that the model has a good fit: $\chi^2_{(571)} = 1002.20$, $CFI = .92$, $TLI = .91$ and $RMSEA = .038$. All of the paths were significant and in the hypothesized direction. Please see Figure 1 for the full model with the standardized regression coefficients. The results support that self-determined motivation was associated with a reduction in physiological indicators and an improvement in healthy eating and life satisfaction over time. In agreement with the studies of Slovinec-D'Angelo et al. (2007, 2014), an alternative model was also tested that examined whether motivation was a better mediator between self-efficacy and healthy eating, compared to self-efficacy as a mediator between motivation and healthy eating. The fit of the alternative model is the following: $\chi^2_{(566)} = 1067.33$, $CFI = .91$, $TLI = .88$ and $RMSEA = .04$. Like in the hypothesized model, all of the paths were significant and in the expected direction. To confirm which model was a better fit of the data, the *AIC* values were compared between the two models. The results suggest that the *AIC* values were lower in the hypothesized model ($AIC = 1264.20$), compared to the alternative model ($AIC = 1339.33$). These results support that the hypothesized model has a better fit and that self-efficacy is a better mediator between motivation for healthy eating and adoption of a healthy diet at 6 months.

Discussion

The main objective of this study was to replicate Slovinec-D'Angelo et al. (2007, 2014) models for the regulation of exercise, in the context of the regulation of eating with patients with CVD. The second objective was to examine the role of

Table 2. Descriptive statistics for model variables ($N = 513$).

Variables	*M*	SD	Range
Health indicators			
1. Waist circumference – cm (baseline)	99.83	13.18	61–152
2. Cholesterol – mmol/L (baseline)	4.43	1.26	1.60–12.10
3. Triglycerides – mmol/L (baseline)	1.7	1.05	.30–7.50
4. Waist circumference – cm (12 months)	99.41	12.11	65–142
5. Cholesterol – mmol/L (12 months)	3.74	.93	1.1–7.2
6. Triglycerides – mmol/L (12 months)	1.5	.95	.20–8.5
Healthy eating – baseline			
1. Item 2	3.10	1.15	1–5
2. Item 4	3.16	1.26	1–5
3. Item 6	3.74	.85	1–5
4. Item 8	3.81	.73	1–5
Self-determined motivation – baseline			
1. Intrinsic motivation	5.71	1.09	2.33–7
2. Integrated motivation	5.48	1.33	1.33–7
3. Identified motivation	5.24	1.30	1–7
Non-self-determined motivation – baseline			
1. Introjected motivation	4.09	1.68	1–7
2. Extrinsic motivation	3.33	1.70	1–7
3. Amotivation	3.14	1.61	1–7
Life satisfaction – baseline			
1. Item 1	4.95	1.65	1–7
2. Item 2	5.32	1.57	1–7
3. Item 3	5.42	1.55	1–7
4. Item 4	5.40	1.62	1–7
5. Item 5	4.71	1.20	1–7
Self-determined motivation for healthy eating – 3 months	5.53	1.18	2–7
Non-self-determined motivation for healthy eating – 3 months	3.50	1.23	1–7
Self-efficacy for healthy eating – 3 months			
1. Item 1	5.52	1.53	1–7
2. Item 2	5.09	1.52	1–7
3. Item 3	5.31	1.46	1–7
4. Item 4	5.55	1.33	1–7
Healthy eating – 6 months			
1. Item 2	3.72	.97	1–5
2. Item 4	3.75	.99	1–5
3. Item 6	4.15	.49	3–5
4. Item 8	4.14	.48	3–5
Life satisfaction – 12 months			
1. Item 1	5.46	1.32	2–7
2. Item 2	5.75	1.28	2–7
3. Item 3	5.84	1.27	2–7
4. Item 4	5.68	1.28	2–7
5. Item 5	5.26	1.66	1–7

healthy eating on the physical and psychological health of these individuals over time. Finally, this study was conducted to examine the roles of both motivation and self-efficacy as mediating variables in the process of the initiation and the maintenance of health behaviour change. When the model was tested, all hypotheses (1–7) were supported.

The results suggest that self-determined patients are more likely to report higher quality motivation for healthy eating and more likely to maintain healthy eating habits over time. In accordance with SDT, individuals who were generally self-determined were also self-determined in the context of healthy eating, while individuals who were generally non-self-determined were also non-self-determined in the context of healthy eating. These results are consistent with other studies (Pelletier and Dion, 2007; Pelletier et al., 2004) that have also examined the association between general and contextual motivation for the regulation of eating in different populations. These findings support that not all types of motivation lead to the adoption of a healthy diet and more specifically, that self-determined individuals are more likely to initiate and sustain behaviour change and adopt a healthy diet, which leads to positive improvements in physical and psychological health.

In regard to the relationship between motivation and self-efficacy, it can be estimated that self-determined individuals were generally more confident in their abilities to adopt healthy eating habits than non-self-determined individuals. These results are consistent with Slovinec-D'Angelo et al. (2014), who found that forms of self-determined motivation reinforced the perception of self-efficacy, whereas non-self-determined forms of motivation weakened the perception of self-efficacy. The results suggest that self-determined individuals were more likely to adopt healthy eating habits, not only because they were motivated by self-determined reasons, but also because they had more confidence in their abilities to adopt these habits. These results support the propositions of Rothman et al. (2004), where motivation and self-efficacy are distinct and significant determinants of the initiation in the process of behaviour change. Patients with CVD who reported having self-determined motivation and a high level of self-efficacy were more likely to benefit from an improvement in their physical and psychological health. These results are consistent with the study by Pelletier et al. (2004), which demonstrated that the adoption of a healthy diet is associated with improved physiological indicators in individuals at risk for coronary heart disease. Moreover, the results support the proposal of SDT, which posit that self-determined forms of motivation are generally associated with positive consequences, while non-self-determined forms of motivation are generally associated with negative consequences. For future research, it would be interesting to examine whether self-determined individuals report increased motivation to change other health behaviours (e.g. smoking) that increase their risk of developing CVD.

Roles of motivation and self-efficacy in the process of behaviour change

In this study, one of the objectives was to examine whether motivation or self-efficacy represent a better mediator for predicting the initiation of healthy eating. Consistent with Slovinec-D'Angelo et al. (2014), it was observed that the model supported that self-determined motivation is a significant predictor of self-efficacy and that self-efficacy is a significant predictor of adopting a healthy diet. Although SCT posits that self-efficacy determines individuals' motivation for engaging in a particular behaviour, the present models show the opposite relationship. Both motivation and self-efficacy appear to play important roles in the process of behaviour change; self-determined motivation influences the decision to engage in a healthy behaviour and self-efficacy influences individuals' confidence in their abilities to perform a behaviour change. As motivation and self-efficacy both seem to have significant contributions in the process of behaviour change, it is important that future models examining health behaviours continue to examine both concepts and their respective

roles in predicting the initiation and maintenance of health behaviours.

Implications for interventions

The findings of this study have important implications for interventions for patients with CVD. Since the results suggest that self-determined motivation is an important first step of health behaviour maintenance, it is important that interventions promote self-determined motivation. Traditionally, interventions often focus on behaviour change in the short term and few interventions focus on the psychological processes underlying the maintenance of health behaviours in the long term (Teixeira et al., 2011). In order for patients with CVD to incorporate healthy eating into their daily lives, health professionals should encourage individuals to consider the importance of adopting a healthy diet. Research in SDT has shown the importance of supporting individual's basic psychological needs (autonomy, competence and relatedness) in improving motivation quality (Deci and Ryan, 2008). Autonomy support from health professionals is an approach that has been proven to be effective in the treatment of many health behaviours (Ng et al., 2012, for a review). For example, patient autonomy in the health system is supported when providers listen to their patients, recognize their perceptions, and offer choices and initiatives about how to manage their health, while minimizing pressure and control. Previous studies have also demonstrated the importance of targeting motivation for the maintenance of health behaviours in individuals at risk. For example, in a study of severely obese individuals, Williams et al. (1996) demonstrated that autonomy support from health professionals was a good indicator of self-determined reasons for engaging in the programme. Although motivating individuals by external incentives may seem like an effective way to intervene, this approach thwarts autonomy and may promote a non-self-determined motivation for patients. Therefore, it may not help change behaviours in the long term or encourage individuals to internalize health behaviours into their daily lives.

Since self-efficacy has been identified as an important mediator between motivation and healthy eating, healthcare professionals should also aim to improve patients' perceptions about their abilities to adopt healthy eating habits. Healthcare professionals can enhance self-efficacy by helping the patients take small steps during the recovery process. As the patient progresses, healthcare providers can encourage them and support their achievements and attribute their accomplishments to their abilities (Strecher et al., 1986). Several studies have demonstrated that an intervention based on supporting autonomy and competence has beneficial effects on the health of individuals (Williams et al., 1998, 2004). An intervention that aims to increase autonomous motivation and perceived self-efficacy could potentially be adapted to the specific needs of individuals. For example, an individual who is generally self-determined but does not have the confidence in his abilities could benefit from an intervention based on increasing their self-efficacy, whereas an individual who is generally non-self-determined and does not have confidence in their abilities could benefit from an intervention based on the promotion of autonomous motivation, followed by an intervention based on increasing self-efficacy perception.

Limitations and future research

Despite these interesting results, it remains important to identify the limitations of the study. First, since this study was longitudinal and included participants that all had a diagnosis of myocardial infarction or acute coronary syndrome and, according to their physician, had to change their eating habits to improve their health and reduce their risk of having more serious complications, many participants withdrew from the study after baseline. Although all the precautions were taken to keep track of all participants and the participants at Time 4 did not differ from the sample at baseline with regard to the severity of their diagnosis, it was impossible to know whether the rate of attrition could be attributed to a decline in health for some participants. Second,

the study sample was predominantly male. A replication study in a population composed of women could help further generalize the results to the cardiac population. Finally, it would be interesting for future research to replicate the motivational models on other behavioural risk factors of CVD or a combined study of these factors (e.g. the practice of physical activity, smoking cessation or reduced alcohol consumption). These studies are of interest since the maintenance of all health behaviours is an ideal way to promote the overall health of patients with CVD, and very few studies have examined the behaviours of overall health among individuals in this population.

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