APPLIED PSYCHOLOGY

APPLIED PSYCHOLOGY: AN INTERNATIONAL REVIEW, 2008, *57* (4), 628–643
doi: 10.1111/j.1464-0597.2008.00344.x

Physical Activity and Social Cognitive Theory: A Test in a Population Sample of Adults with Type 1 or Type 2 Diabetes

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The purpose of the study was to test the Social Cognitive Theory (SCT; Bandura, 2004) for explaining physical activity (PA) in a large population sample of adults with type 1 or type 2 diabetes. Study objectives: (1) test the fit of the SCT structure in the total sample, and the diabetes sub-types; (2) determine the SCT structural invariance between the type 1 and type 2 groups; and (3) report explained variance and compare strength of association for the

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RCP is supported by Salary Awards from the Alberta Heritage Foundation for Medical Research and the Canadian Institutes for Health Research (CIHR) Applied Public Health Chair Program. SL was funded through a CIHR New Emerging Team Grant during the time of this research. KSC is supported by the Canadian Research Chair Program. RJS is funded by the Ontario Ministry of Health, Scientist Career Award. We would like to thank Nandini Karunamuni for her assistance in preparing this manuscript.

SCT constructs in predicting PA for both type 1 and type 2 groups. In all, 2,311 individuals with type 1 or type 2 diabetes were assessed on their self-efficacy, outcome expectancies, impediments, social support, goals, and physical activity at baseline and 1,717 (74.5%) completed these assessments again at 6 months. Multi-group Structural Equation Modeling was conducted. The findings provide evidence for the utility of the SCT in the diabetes samples. The SCT fits individuals with type 1 and type 2 diabetes except for SCT impediments, which appear to be obstructing goal-setting in individuals with type 2 diabetes only. Promotion of health behavior should target self-efficacy to set goals and change behavior. Outcome expectancies and social support are also important factors for setting goals and behavior performance.

Objectifs. Mettre à l'épreuve la théorie cognitivo-sociale (SCT de Bandura, 2004) dans l'explication de l'activité physique (A.P.), cela dans un grand échantillon tiré de la population des adultes souffrant des types 1 ou 2 de diabète. Les buts de la recherche: 1) Evaluer la pertinence de la structure SCT pour l'ensemble de l'échantillon et pour les formes de diabète; 2) Déterminer l'invariance structurelle de la SCT entre les groupes de type 1 et de type 2 et 3) indiquer la variance expliquée et comparer la puissance des concepts SCT dans la prédiction de l'A.P. pour les deux groupes (type 1 et type 2). *Méthodes.* On a d'abord évalué l'auto-efficience, l'espoir d'un résultat, les difficultés rencontrées, le support social, les objectifs et l'activité physique de 2,311 individus présentant des diabètes de type 1 ou de type 2; ensuite 1717 (74,5 %) ont redonné six mois plus tard des renseignements sur ces différentes rubriques. Le modèle d'équation structurel multigroupes a été appliqué. *Résultats.* Des indices de l'intérêt du SCT apparaissent pour l'analyse des échantillons de diabétiques. Le SCT est en adéquation avec les individus présentant un diabète de type 1 ou de type 2 à l'exception de la variable « difficultés rencontrées » qui contrecarre le but poursuivi seulement pour les diabétiques de type 2. *Conclusions.* Le développement de conduites liées à la santé devrait se centrer sur l'auto-efficience pour établir des objectifs et modifier les comportements. Les espoirs de résultats et le support social sont aussi des facteurs importants dans la fixation d'un but et la performance comportementale.

INTRODUCTION

Given the increasing prevalence of individuals with diabetes (WHO, 2006), there have been urgent calls for the need for effective prevention and treatment strategies (Rathmann & Giani, 2004). Physical activity (PA) plays a key role in both the delay of the onset of type 2 diabetes (T2D) (Avenell, Broom, Brown, Poobalan, Aucott, Stearns, Smith, Cairns, Jung, Campbell, & Grant, 2004) and in the management of type 1 (T1D) and T2D (Sigal, Kenny, Wasserman, & Castaneda-Sceppa, 2004). Furthermore, individuals with diabetes are at a higher risk for developing other chronic disorders such as cardiovascular disease and cancer, which are preventable through regular PA (American College of Sports Medicine, 1997). PA may also act as a facilitator for other health behaviors such as healthy eating and avoiding smoking (Wing, Goldstein, Acton, Birch, Jakicic, Sallis, Smith-West, Jeffery, & Surwit, 2001). Despite the widely known benefits of PA, a high proportion of the population (Kahn, Ramsey, Brownson, Heath, Howze, Powell, Stone, Rajab, Corso, & Task Force on Community Prevention Services, 2002) and especially individuals with diabetes are not physically active (Lees & Booth, 2004). Therefore, motivating individuals with diabetes to be more physically active is an important topic of concern that needs to be further investigated.

There is evidence that theory-based interventions are more efficacious than atheoretical approaches (Biddle, Hagger, Chatzisarantis, & Lippke, 2007). Empirically testing theories is an important step that needs to be carried out prior to using them for interventions. Bandura's *Social Cognitive Theory* (SCT) is a widely recognised theory that describes factors that affect and determine behavior (Bandura, 1997). SCT also specifies mechanisms through which the determinants work and how they may be translated into effective health practice (Bandura, 2004). The core constructs of Bandura's theory are goals, perceived self-efficacy, outcome expectancies, facilitators, and impediments. *Goals* direct the behavior. Perceived *self-efficacy* is the belief that one is capable of performing the goal behavior in spite of obstacles. *Outcome expectancies* are the perceived costs and benefits of the behavior, that is, the expectation that an outcome will follow a given behavior that would be beneficial for oneself. *Facilitators* and *impediments* are social structural factors that include environmental aspects that could potentially predict goals and behavior. These components and the theory's structure have been tested and reviewed across numerous populations and domains of human behavior and health promotion (*self-efficacy*; see Robbins, Lauver, Le, Davis, Langley, & Carlstrom, 2004; *outcome-expectancies*; see Williams, Anderson, & Winett, 2005; and *goal-setting*; see Shilts, Horowitz, & Townsend, 2004).

The SCT's structure and predictive ability have been tested in the PA domain (e.g. Conn, Burks, Pomeroy, Ulbrich, & Cochran, 2003; Resnick, Orwig, Magaziner, & Wynne, 2002; Resnick, Palmer, Jenkins, & Spellbring, 2000). Such studies have shown that self-efficacy is the most important factor in predicting behavior (Keller, Fleury, Gregor-Holt, & Thompson, 1999; Senecal, Nouwen, & White, 2000; Williams & Bond, 2002), and that self-efficacy and barriers are moderately negatively related (Conn et al., 2003). Moreover, self-efficacy and outcome expectancies appear to be highly positively interrelated (Conn et al., 2003; Resnick et al., 2002; Rovniak, Anderson, Winett, & Stephens, 2002). In a longitudinal test of the theory, McAuley, Jerome, Elavsky, Marquez, and Ramsey (2003) reported that social support and self-efficacy were highly correlated and that self-efficacy mediated social support and subsequent PA behavior.

The SCT components generally explain approximately 40–55 per cent of the variance for PA behavior. In cross-sectional studies, Conn et al. (2003) found that self-efficacy, barriers, and outcome expectancies (adjusted for age, health, and processes of change) explained 46 per cent of the behavior variance, while Resnick et al. (2002) reported that self-efficacy, social support, and outcome expectancies (adjusted for age) explained 53 per cent of the variance for PA (Resnick et al., 2002). In longitudinal studies Rovniak et al. (2002) employed an SCT model that included social support, self-efficacy, outcome-expectancies, goals, and plans. The authors showed that these constructs explained 55 per cent of the variance for PA in young adults at 8 weeks. On the contrary, McAuley et al. (2003) report that their best fitting model accounted for 40 per cent of the variation in PA maintenance. Although the above studies examined the structure of SCT, they included other factors and excluded important constructs proposed by Bandura (2004), such as goals and barriers. To date, it appears that the broader SCT has not yet been fully tested in any single study.

SCT's ability to predict PA in the diabetic population has been rather limited. Most of the studies focus on the examination of one or a few of the theory's constructs (Allen, 2004); SCT's structural model to predict PA in this population has yet to be examined. Allen's (2004) review revealed 13 studies on this topic. Briefly, sample sizes ranged from 46 to 118 people, 10 studies assessed type 2 diabetes individuals, 10 were correlational studies, all studies measured self-efficacy, and five assessed outcome expectations. All studies in the review reported a significant association between self-efficacy and PA, while mixed results were reported for the relationship between outcome expectations and PA (Allen, 2004). Although only one study in this review examined social support, there is ample evidence that social support strategies are effective for PA promotion in those living with diabetes (Gallant, 2003; Karlsen, Idsoe, Hanestad, Murberg, & Bru, 2004; Keller et al., 1999; Williams & Bond, 2002).

Further, it appears that no study to date has examined the predictive ability of SCT (or any other socio-cognitive theory/model) between T1D and T2D individuals. Given the well-established etiological and physiological differences between T1D and T2D (Canadian Diabetes Association, 2003), and differences in the reported demographic, health, and behavioral characteristics between these two groups—e.g. those with T2D tend to be less active, older, and overweight/obese—as well as the differences in the health/medical and demographic PA predictors between the T1D and T2D groups (Plotnikoff, Taylor, Wilson, Courneya, Sigal, Birkett, Raine, & Svenson, 2006), it may also be likely that such PA social-cognitive constructs and their orchestration in predicting behavior are different between the two diabetes types. It is therefore desirable to separately analyse data for these groups to test for any cognitive differences on factors associated with PA change. Psychological differences related to PA between the groups and the relevance of motivational interventions for the groups are unknown. It is therefore important to examine the differences and similarities between the two diabetes groups, to generate theoretical evidence to guide appropriate PA behavior change strategies for these target populations.

The purpose of the study was to test the SCT for explaining PA in a large population sample of adults with T1D and T2D. The study objectives were to: (1) test the fit of the SCT structure in the total sample, and the diabetes sub-types (i.e. T1D and T2D); (2) determine the SCT structural invariance between the T1D and T2D groups; and (3) report the explained variance and compare the strength of association for the SCT constructs in predicting PA for both T1D and T2D groups (our main study objective). The ultimate aim of this research is to guide PA interventions and programs for this population.

METHODS

Procedure and Sample

The current study reports the social-cognitive theory results from the Alberta Longitudinal Exercise and Diabetes Research Advancement (ALEXANDRA) Study (Plotnikoff et al., 2006)—a population-based, longitudinal assessment of PA determinants in adults with diabetes. The specific details of the procedure, sample, and specific response rates are reported elsewhere examining the demographic and medical correlates of PA (Plotnikoff et al., 2006).

At time 1, a sample of 2,319 individuals that had been diagnosed with diabetes (type 1 or type 2) provided data. Eight individuals were excluded from the study, as they did not provide information on the type of diabetes they had. Out of the 2,311 individuals (697 T1D; 1,614 T2D) 1,717 (74.5%) completed a PA assessment at 6 months. The mean age of T1D and T2D was 51.1 ± 17.1 and 63.0 ± 12.1 years, respectively. In the T1D group, 54 per cent of the participants were female, and 44 per cent of the participants had completed university. In the T2D group, 49 per cent were female, and 34 per cent of the participants had completed university. The demographic characteristics of our study generally reflect Canada's diabetic population in terms of age and sex distributions (Statistics Canada, 2001).

Dropouts revealed no differences for gender, income, and education ($p > .10$). However, significant differences were found for marital status ($p = .01$): of the unmarried participants, 29.7 per cent dropped out compared with only 24.2 per cent of married individuals. Dropouts were also younger and had a higher BMI than individuals who completed the 6-month follow-up ($p < .01$). We imputed study dropouts to examine the effects.

Measures

Socio-demographic factors were measured using questions based on the Statistics Canada 2001 census (Statistics Canada, 2001) and included: age, sex, ethnic origin, marital status, educational level, and gross annual family income. *Health factors* were assessed using previously published self-report measures (Plotnikoff, Brez, & Hotz, 2000) to determine diabetes type, height, and weight (used to calculate body mass index); daily use of insulin or oral antihyperglycemic medication; age of diagnosis, cardiovascular disease (angina, past myocardial infarction), and cardiovascular disease risk (elevated blood pressure, cholesterol levels).

Physical activity behavior was assessed using a modified version (Plotnikoff et al., 2006) of the validated Godin Leisure-Time Exercise Questionnaire (GLTEQ; Godin & Shephard, 1985) that asked participants to report the average number of times and average duration (minimum of 10 minute bouts) per week in the past month they engaged in strenuous (rapid heart beats, sweating) and moderate (not exhausting, light perspiration) PA. Participation responses in each intensity category were then added to obtain a sum score of minutes per week.

Social-Cognitive Variables

Behavioral Goal was assessed with a single item (Courneya, Plotnikoff, Hotz, & Birkett, 2000). Participants were asked on a scale of 0 per cent to 100 per cent, "How likely is it that you will get regular PA within the next 6 months?" *Self-Efficacy* was measured with a 13-item scale, consisting of eight core items from an existing validated measure (Plotnikoff, Blanchard, Hotz, & Rhodes, 2001) along with five additional items developed for this specific population. Participants were asked to rate their confidence (*1 = not at all confident* to *5 = extremely confident*) that they could participate in regular PA over the next 6 months when: a little tired, in a bad mood or feeling depressed, doing it by themselves, it became boring, there are no noticeable improvements in fitness, having other demands, feeling stiff or sore, there is bad weather, having to get up early even on weekends, having diabetes-related complications, having to find different activities due to diabetes complications, when a little ill, and when having to let others know that they have diabetes. Cronbach's alpha was .95 for the total sample and the T1D and T2D groups.

Positive Outcome Expectation (seven items) was measured with five general items (from the validated exercise pros subscale validated by Plotnikoff et al., 2001) with two additional items developed for this specific population. The items in the scale assessed the extent to which individuals agreed or disagreed (*1 = strongly disagree* to *5 = strongly agree*) that participating in regular PA over the next 6 months would for them: reduce tension or manage stress; feel more confident about one's health; sleep better; have a more positive outlook; help control weight; decrease the chances of having further diabetes complications; and help control glucose levels. Cronbach's alpha was .88 for the total sample and the two diabetes groups.

Impediments (10 items) were measured with five general items from the validated exercise cons sub-scale developed by Plotnikoff et al. (2001) along with five diabetes-specific items developed for this population. As in the positive outcomes measure, the items for this scale also assessed the extent to which individuals agreed or disagreed (*1 = strongly disagree* to *5 = strongly agree*) that participating in regular PA over the next 6 months would for them: take too much of my time, have less time for my family and friends; make one too tired because of other daily responsibilities; make one worry about looking awkward if others saw them being physically active; cost too much money; require monitoring blood glucose levels more closely; lead to an insulin reaction; require letting others know one has diabetes; require reliance on others if complications occur; and cause physical injury. Cronbach's alphas were .72, .73, and .73 respectively for T1D, T2D, and the total sample.

Social Support was measured using a two-item scale (Courneya et al., 2000). Participants were asked whether over the next 6 months people in their social network were likely to help them participate in regular PA, and whether they felt that someone in their social network would provide the support they needed in order to be regularly physically active. The respective correlations between the two items were .54, .59, and .57 for the T1D, T2D, and total sample groups, respectively. All 6-month time referent was provided for all the above social-cognitive constructs. "Regular physical activity" was defined as achieving at least 30 minutes of moderate and/or vigorous intensity activity five times a week which is consistent with national guidelines for diabetes (Canadian Diabetes Association, 2003). A qualitative protocol that included focus groups and cognitive interviews was conducted on 24 diabetic men and women to ensure the content appropriateness and wording of the above scale items.

Data Analysis

Descriptive statistics (i.e. means, *SD*; intercorrelations) as well as reliability, mean difference tests (*t*-tests), and dropout analyses (Chi^2- and *t*-tests) were performed using SPSS 12.0.1.

For *Research Objective 1* (i.e. testing the fit of the SCT model structure), structural equation modeling (SEM) with manifest factors was employed. This was done for several reasons. First, the underlying theoretical order among the factors and relationships among predictors can be tested.

Thus, to test the *Research Objective 2* (determining the SCT structural invariance between the two diabetes type models, i.e. that no difference exists between the two groups), Multi-group Structural Equation Modeling (MSEM) was applied. When the theory underlying the model indicates that a moderating relationship among predictors may vary by specific population subgroups, such as the two diabetes groups, MSEM is preferable. A single χ^2 goodness-of-fit statistic evaluates a set of complex models—one for each group. To validate the usual assumptions that groups are equivalent, sub-samples are required to have identical estimates for all parameters (i.e. a "fully constrained" model). Differences among the groups can be evaluated for their appropriateness by "freeing" special parameters or allowing the groups to vary.

The theoretical model is separately applied to each subgroup and then the invariance analyses are conducted. Before the invariance models can be estimated, it must be established that the model without any invariances (i.e. a model that is different in each group) is "acceptable". This model can be used as a basis of assessment of more constrained models. The constraints are placed in a sequence of nested models. To compare the models, the χ^2 difference test and the Tucker-Lewis index can be used to test the equality constraints (Marsh, Hau, & Wen, 2004; Kenny, 2005). If the difference between the χ^2-statistics is not statistically significant then the statistical evidence points toward no cross-group differences between the constrained parameters (precondition for testing Research Objective 2). If the χ^2 difference is statistically significant, then the evidence of cross-group inequality exists. The Tucker-Lewis Index estimates the models for the groups separately and sums the χ^2s and the degrees of freedom. Differences in the TLI up to .05 are considered trivial in practical terms. For the test of significant paths and significant differences across the subgroups, $p \leq .10$ was used because unidirectional hypotheses were stated.

To complete *Research Objective 3* (i.e. determine the explained variance and compare the strength of regression paths of the SCT constructs in predicting PA for both diabetes type models; our main study objective), the factor interrelation equivalence model was examined to determine if there were significantly different regression paths for the two diabetes groups. This was done in order to examine the regression paths unconstrained for each of the two diabetes groups, and to examine the explained variance of goals and behavior for each group. The analyses were conducted to test a longitudinal model (baseline social-cognitive measures and the 6-month PA measure).

SEM was performed using AMOS 4.01 employing the AMOS Graphics. To test whether the path coefficients were significantly different, we employed AMOS Pairwise Parameter Comparison. We employed the Full Information-Maximum Likelihood Model (FIML) to impute and examine the effects of the 6-month study dropouts; however, an almost identical pattern was revealed between the imputed and non-imputed models. Thus imputed models are not reported in this paper.

TABLE 1
Means, Standard Deviations and Pearson Correlations for Individuals with Type 1 (first row) and Type 2 (second row) Diabetes

Variable	M *(SD)*	*Self-Efficacy*	*Outcome Expectations*	*Cons*	*Social Support*	*Intention*	*Behavior (t1)*	*Behavior (t2)*
Self-Efficacy	3.18 (0.85)	—						
	3.10 (0.87)*							
Outcome Expectations	3.83 (0.86)	.53	—					
	3.84 (0.84)	.47						
Impediments (Cons)	2.16 (0.66)**	–.21	.03	—				
	1.87 (0.63)	–.29	.02					
Social Support	3.16 (0.85)**	.25	.26	–.11	—			
	2.98 (0.90)	.16	.24	.01				
Goals	71.43 (27.74)	.70	.54	–.08	.26	—		
	68.98 (28.72)	.76	.50	–.27	.19			
Behavior (t1)	143.64 (144.09)*	.47	.28	–.12	.24	.47	—	
	130.74 (132.27)	.44	.21	–.17	.11	.43		
Behavior (t2)	183.25 (131.80)	.35	.22	–.12	.15	.34	.57	—
	178.98 (134.09)	.29	.18	–.15	.08	.27	.43	

Note: Significant differences in means between individuals with type 1 and type 2 diabetes are indicated.
* $p < .01$; ** $p < .05$.

RESULTS

Descriptive, Manifest Statistics

The correlations among the variables, the scale means, and standard deviations for each of the measured variables in the model are displayed separately for type 1 and type 2 diabetes in Table 1.

Differences in the means between the two groups were found in impediments, goals, and behavior: type 1 diabetics perceived more impediments, reported stronger goals to exercise, and more weekly minutes of physical activity. However, these differences in activity were significant at baseline but not at 6 months.

Testing the Structure of the SCT (Research Objective 1)

The longitudinal model fit statistics indicated that the fit of the structural model was excellent for the T1D group and good for the T2D group (see Table 2, Panel A).

Given that the structure of all the models was acceptable, this justified MSEM (i.e. examining T1D and T2D groups simultaneously for assessing differences between the two groups).

TABLE 2
Panel A. Goodness of Fit Indices for the Total and the Two Sub-samples of the SCT Structural Model

	Goodness of Fit Indices							
Sample	n	χ^2	*df*	χ^2/df	p	*TLI*	*CFI*	*RMSEA*
All (Type 1 and 2 combined)	1,717	8.65	2	4.32	.01	.99	.99	.04
Type 1	524	2.68	2	1.34	.26	.99	.99	.03
Type 2	1,193	7.65	2	3.83	.02	.99	.99	.05

Panel B. Two Group Nested Models and χ^2 Differences with Increased Constraints

Model	χ^2	*df*	p	χ^2/df	*TLI*	*CFI*	*RMSEA*	*Model 1 delta* χ^2	*Model 1* p	*Delta TLI*
Unrestricted model	10.33	4	.04	2.09	2.58	.99	.03	—	—	—
Factor interrelation equivalence model	20.90	10	.02	1.07	2.09	.99	.03	10.57	.10	<.01
Paths and factor interrelation equivalence model	36.41	17	<.01	1.75	2.14	.99	.03	26.08	.02	<.01
Fully constrained	43.13	19	<.02	1.82	2.27	.99	.03	32.80	<.01	<.01

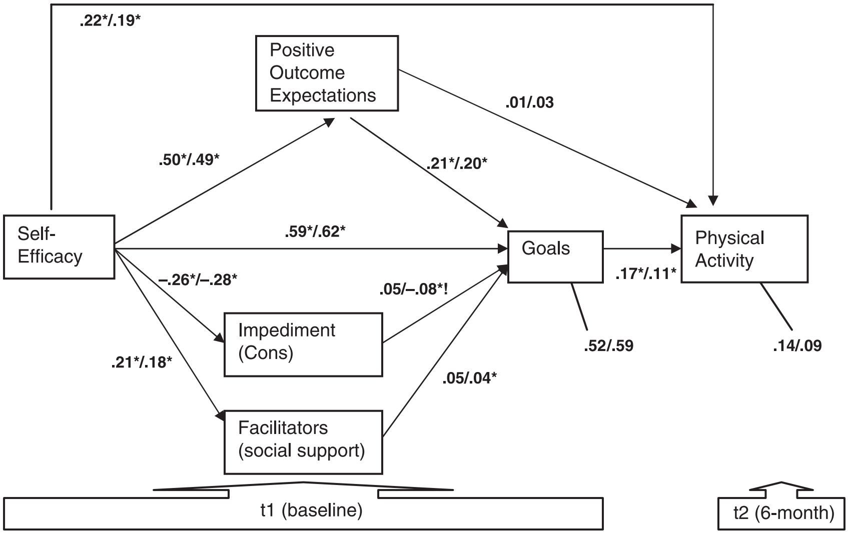
Evaluation of the Structural Differences between T1D and T2D (Research Objective 2)

The first constrained model was tenable in the longitudinal tests, with practical fit indices showing good model fit (Table 2, Panel B). The χ^2 differences were not statistically significant for the *factor interrelation equivalence model* ($p > .10$). This confirms that these models account as well for the sample's variance/covariance as the unrestricted model. The other models proved to be applicable at $p \leq .02$, suggesting that paths and factor residuals were to some extent sample specific (Table 2, Panel B).

Effects of the SCT Variables on Physical Activity (Research Question 3)

To test where the differences between the diabetes groups occur, dissimilarities in the paths were tested in the *factor interrelation equivalence models* (cf. Methods section). Predicted associations were tested between the baseline SCT variables with 6-month PA (Figure 1).

Self-efficacy was the main predictor of goals and subsequent behavior in both diabetes groups. In both groups, self-efficacy was significantly



Note: Paths are reported Type 1/Type 2 Diabetes.
* < .01;
! significantly different paths.

FIGURE 1. SCT—Standardised coefficients for the factor interrelation equivalence model across the two diabetes samples.

interrelated with positive outcome expectancies, impediments, and social support. The association of self-efficacy and positive outcome was $\beta_{\text{Type 1}}$ = .50, $\beta_{\text{Type 2}}$ = .49. The relationship of self-efficacy and impediments was $\beta_{\text{Type 1}}$ = –.26, and $\beta_{\text{Type 2}}$ = –.28. The association of self-efficacy and social support was $\beta_{\text{Type 1}}$ = .21, $\beta_{\text{Type 2}}$ = .18.

Although *self-efficacy* was mediated by the other social-cognitive factors, the direct path of self-efficacy on goals was significant ($\beta_{\text{Type 1}}$ = .59, $\beta_{\text{Type 2}}$ = .62). The same was true for the effect on behavior ($\beta_{\text{Type 1}}$ = .22, $\beta_{\text{Type 2}}$ = .19). *Outcome expectancies* were significantly associated with goals ($\beta_{\text{Type 1}}$ = .21, $\beta_{\text{Type 2}}$ = .20) but not with behavior. Higher *impediments* were significantly correlated with weaker goals only in individuals with T2D ($\beta_{\text{Type 2}}$ = –.08). However, this association was higher and significantly different between T1D and T2D (CR > 1.96). There was also a small but significant relationship of *social support* with goals with the T2D group ($\beta_{\text{Type 2}}$ = .04). Stronger *goals* at baseline were associated with higher levels of PA at 6 months ($\beta_{\text{Type 1}}$ = .17, $\beta_{\text{Type 2}}$ = .11).

The *explained variance* of goals was higher in the T2D group than in the T1D group ($R^2_{\text{Type 1}}$ = .52, $R^2_{\text{Type 2}}$ = .59). The explained variance for PA behavior was higher in the T1D group than in the T2D group ($R^2_{\text{Type 1}} = .14$, $R^2_{\text{Type 2}} = .09$).

DISCUSSION

The aim of the study was to test the SCT in explaining PA in a large population sample of T1D and T2D adults. This is the first study testing the structure, fit, and explanatory strength of the SCT in predicting PA in this population. Overall, the results confirm the structural assumptions and internal validity of SCT for this population, providing support for the application of SCT for promoting PA in persons with diabetes.

The model fit indices confirmed the SCT's structure for the overall sample and both of the diabetes sub-group types (Research Objective 1) with some structural differences between the T1D and T2D groups (Research Objective 2). The SCT respectively explained approximately 52 per cent and 59 per cent of the variance for goals for T1D and T2D groups, and 14 per cent and 9 per cent for 6-month PA behavior for the respective diabetes groups.

Differences between the two diabetes groups were found in terms of T1D individuals perceiving more self-efficacy, impediments, and social support and reporting more weekly minutes of PA at baseline. All interrelations of the social-cognitive variables and most paths were similar in the two groups, with one exception: higher impediments were correlated with weaker goals in the T1D group. In the T2D group the interrelation between impediments and goals was not significant.

For the T1D group, less of the variance of goals and more of the variation of behavior was explained than in the T2D group. However, in both diabetic samples, we could only account for approximately half as much of the behavior variance as in studies with non-diabetic samples (Conn et al., 2003; McAuley et al., 2003; Rovniak et al., 2002). Reasons for this may include numerous and specific problems which adults with diabetes have to deal with, quality of diabetes management and care in Canada, and a possible greater intention–behavior gap with this chronic disease population.

As in previous studies (Allen, 2004), we found that self-efficacy is the most important factor in predicting behavior, and that self-efficacy and social support are highly correlated (McAuley et al., 2003). Moreover, as reported elsewhere (Brassington, Atienza, Perczek, DiLorenzo, & King, 2002), self-efficacy is a much stronger predictor than social support. Furthermore, in accordance with other research (Conn et al., 2003; Resnick et al., 2002; Rovniak et al., 2002), high interrelations between self-efficacy and outcome expectancies were also found. As in other studies with diabetic samples, self-efficacy was more important than outcome expectancies in predicting PA behavior (Allen, 2004; Williams & Bond, 2002). Our finding, that impediments were obstructive in T2D individuals, is also in line with the research of Wen, Shepherd, and Parchman (2004) who found that decreasing barriers improved exercise behavior in older T2D Mexican Americans.

Our findings clearly support the need to target self-efficacy to set goals and change behavior in PA promotion which has been shown to be successful in other research (Allison & Keller, 2004; Burke, Giangiulio, Gillam, Beilin, & Houghton, 2004). Strategies to increase the perceived confidence in one's ability to take PA action could include: providing training and guidance in performing the activity, using progressive goal-setting, giving verbal reinforcement, demonstrating the desired behaviors, and reducing anxiety (Bandura, 2004).

Outcome expectancies and social support are also important factors to improve goal-setting and behavior. Both have been shown to be helpful in increasing PA in different age groups (Kahn et al., 2002). Hallam and Petosa (2004) successfully targeted SCT constructs (e.g. outcome expectancies, social support, self-efficacy, and goal-setting) and increased levels of exercise in the intervention group. The American College of Sports Medicine suggests promoting PA with principles of behavior change which include the SCT constructs of social support, self-efficacy, and goal-setting (American College of Sports, 1997).

Despite the different etiology, physiological, health, demographic, PA behavior (and PA's demographic determinants), there were no significant differences between the two groups on any of the analyses testing this theory. In other words, the theory works equally well in both diabetes types. Essentially, our study provides evidence towards the utility for practitioners and researchers to operationalise and evaluate appropriate PA interventions based on SCT for both types of diabetes.

The study's limitations include: the self-report of behavior, measurement issues (i.e. no latent model, a proxy measure to assess the *goal* construct, and not all possible components of Bandura's SCT Model were assessed—i.e. taking into consideration all environmental and contextual factors). Despite these shortcomings, the strengths of this study are to our knowledge: the first study in the diabetic population to examine SCT's internal structure; the largest sample and first population-based study to examine SCT in the PA domain with a diabetic population; one of the first studies in the social-cognitive literature across any behavior to compare a psychosocial model between T1D and T2D groups; the employment of MSEM; and the prospective design in our test of SCT.

These findings will hopefully guide needed research towards the operationalisation and testing of SCT interventions in experimental designs. Future research is also warranted in the testing of other competing social-cognitive theories (e.g. Theory of Planned Behavior, Protection Motivation Theory, Transtheoretical Model) in this population for explaining PA behavior. Further, the direct comparison of diabetic samples with the general population is required in determining the appropriateness, utility, and impact of general population health approaches on those living with diabetes versus the degree to which messages and strategies must be tailored for this specific target population group.

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