Physical Activity Behavior, Motivational Readiness and Self-Efficacy among Ontarians with Cardiovascular Disease and Diabetes

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This cross-sectional study examined physical activity and its correlates among 355 diabetes, 144 cardiovascular disease, 75 diabetes and cardiovascular disease, and 390 residents with cardiovascular risk factors. Community residents ($N = 2566$) were screened by telephone, and 964 participants completed a self-report survey. Non-diabetes participants participated in a greater range of physical activities ($p < .001$), more frequently ($p = .013$). Diabetes participants had lower physical activity readiness and efficacy ($ps < .009$). In a regression model ($p < .001$), region and disease, work, marital and smoking status were significant correlates of physical activity frequency. Interventions which increase motivational readiness and efficacy among diabetics are required to prevent and delay complications, particularly in regions with environmental barriers such as cold weather and homogeneous, low-density land use.

KEY WORDS: physical activity; cardiovascular disease; diabetes mellitus; self-efficacy; motivational readiness.

INTRODUCTION

Physical activity is integral to promoting health and preventing the onset and progression of diseases such as cardiovascular disease and diabetes mellitus (American Diabetes Association., 2002; Brown *et al.*, 2003; Jolliffe *et al.*, 2001; Taylor *et al.*, 2004; Yusuf *et al.*, 2004; Kohl, 2001), including moderate-intensity walking or other lifestyle activities (Franco *et al.*, 2005; Duncan *et al.*, 2005, 2003). Despite the negative outcomes associated with inactivity, many people with cardiovascular disease and/or diabetes are sedentary (Dubbert, 2002; Marsden, 1996).

Research has shown that diabetes mellitus requires lifelong self-management through physical activity for increased longevity, quality of life, and functional independence (American Diabetes Association, 2002). These same lifestyle modifications are required in people with cardiovascular disease to prevent a recurrence, but may be more vital for patients with both cardiovascular disease and diabetes who have heightened risk (Smith *et al.*, 2002). While previous research has examined the correlates of physical activity from a demographic to environmental level in non-medical and cardiac rehabilitation populations (Daly *et al.*, 2002; Trost *et al.*, 2002; Mutrie, 1999), diabetics and broader cardiac samples have been under-studied. Moreover, previous research has established that high cardiovascular risk (Clark, 1999; Ruchlin and Lachs, 1999) and perceived health (Booth *et al.*, 2000) are significant correlates of physical activity in non-medical samples, but scant research has explored physical activity correlates across populations at increased cardiovascular disease risk and in poor health, respectively.

In order to promote physical activity, an examination of the correlates of this behavior is warranted. The purpose of this study was to examine physical activity behavior and its correlates among people with cardiovascular disease, diabetes mellitus, both, or those at an elevated risk of developing these conditions. An examination of established demographic correlates such as sex, age, ethnocultural background, education, and work status (Trost *et al.*, 2002), psychological correlates such as motivational readiness and self-efficacy (Burns *et al.*, 1998; Brawley *et al.*, 2000; Prochaska and Velicer, 1997; Velicer *et al.*, 1990; Conn *et al.*, 2003; Rodgers *et al.*, 2002; Cowan *et al.*, 1997), and environmental correlates such as residence in northern, rural or urban areas (Humpel *et al.*, 2002) was conducted in the context of these chronic conditions. Of particular interest was whether participants with both cardiovascular disease and diabetes mellitus engaged in more physical activity than other participants.

METHODS

Design and Procedure

This constitutes a cross-sectional study from a larger randomized controlled trial (Community Outreach Heart Health Risk Reduction Trial). The participating Ontario sites were targeted as regions with increased cardiovascular disease prevalence, increased risk for related hospitalizations, and modifiable risk factor prevalence (Bondy *et al.*, 1999), namely Sudbury and district (northern), Bruce-Grey counties including Owen Sound and Walkerton (rural), and the Greater Toronto Area (urban).

Multimodal recruitment was conducted through several means: self-referral through advertisements and public health units ($n = 554$; 57.5%), collaboration with family physicians ($n = 320$; 33.2%), proactive random digit dialing (Potthoff, 1994) within each participating region and setting ($n = 79$, 8.2%), and worksites and pharmacists ($n = 11$; 0.1%). Based on a standardized telephone assessment interview and physician referral form, cardiovascular disease risk as defined by the Framingham algorithm was established (Grundy *et al.*, 1999; Wilson *et al.*, 1998). Individuals at elevated risk for cardiovascular disease (i.e. two or more risk factors) were invited to participate. This also included individuals with a diagnosis of atherosclerotic heart disease. Exclusion criteria consisted of: diagnosis of other heart diseases such as valvular disease or cardiomyopathy, atrial fibrillation, or severe congestive heart failure of New York Heart Association (NYHA) class IV (The Criteria Committee of the New York Heart Association, 1994), lack of consenting support from a primary care provider (including nurse-practitioners), residence in an institution, diagnosis of major psychopathology or substance dependence, and significant language comprehension difficulty in English or French. Those who met study criteria and agreed to participate signed a consent form and were invited to the local site, where behavioral and psychological factors were assessed with a self-report questionnaire and where other clinical parameters were also assessed. Ethics approval was obtained for all participating sites.

Participants

An initial telephone screening was conducted for 2566 participants. Participants were asked to continue to the next phase of the study if they had cardiovascular disease, diabetes, or two or more cardiovascular disease risk factors (i.e. males ≥ 55 years; females ≥ 60 years; family history of cardiovascular disease; hypertension; dyslipidemia; current smoker; body mass index ≥ 27). Nine hundred and sixty-four participants were eligible for the study and consented to participate. Cardiovascular disease status was based on confirmation from two or more of the following: physician report, self report, or prescribed cardiovascular disease medication. Diabetes status was based on confirmation from two or more of the following: physician report, self report, physician reported fasting plasma glucose value greater than seven mmol/l, or prescribed diabetes medication. Of the participants with diabetes, almost all (98.7%) had type 2 diabetes, of which 56.4% controlled their condition through anti-hyperglycemic medication and 13.1% through insulin.

Participant characteristics are shown in Table I. In addition to the urban site, there were 311 (32.3%) participants from the rural region, and 134 (13.9%) from the northern region. Distinct cultural communities exist within these participating socio-geographic regions, particularly Afro-Caribbean ($n = 30$, 3.2%), South Asian ($n = 26$, 2.8%), Aboriginal ($n = 22$, 2.3%), and Francophone communities ($n = 18$, 1.9%). Ages ranged from 35–74. The number of years since diagnosis ranged from .08–53 (mean 5.27 ± 8.12) for participants with diabetes,

Table I. Sample Characteristics by Disease Status

Characteristic	CVD ($n = 144$)	DM ($n = 355$)	DM & CVD ($n = 75$)	Neither ($n = 390$)	Total ($N = 964$)
Sex (%female)	48 (33.3%)	208 (58.6%)	35 (46.7%)	217 (55.6%)	508 (52.7%)
Age (mean ± SD)	63.06 ± 6.85	56.15 ± 8.65	61.06 ± 7.50	58.91 ± 8.95	58.61 ± 8.81
Ethnocultural background (%white)	128 (88.9%)	267 (75.2%)	55 (73.3%)	354 (90.8%)	804 (83.4%)
Years of education (mean ± SD)	12.36 ± 3.01	13.62 ± 2.71	13.30 ± 2.89	14.32 ± 2.52	13.76 ± 2.73
Marital status (%married)	110 (76.4%)	224 (63.1%)	46 (61.3%)	277 (71.0%)	657 (68.2%)
Family income (< $50,000CAD/year)	64 (47.4%)	154 (45.2%)	40 (59.7%)	124 (32.9%)	382 (41.5%)
Work status					
% Full time	37 (25.7%)	136 (38.5%)	19 (25.7%)	137 (35.1%)	329 (34.2%)
% Retired	75 (52.1%)	92 (26.1%)	28 (37.8%)	141 (36.2%)	336 (35.0%)
Site (%urban)	40 (27.8%)	207 (58.3%)	29 (38.7%)	243 (62.3%)	519 (53.8%)
Framingham Algorithm – absolute risk (mean ± SD)	13.27 ± 5.42	15.86 ± 8.51	17.50 ± 8.11	13.37 ± 6.77	13.14 ± 8.25
Body mass index (mean ± SD)	29.44 ± 4.90	32.12 ± ±7.01	32.08 ± 7.25	29.26 ± 6.08	30.57 ± 6.50
Waist circumference (mean cm ± SD)	40.17 ± 4.86	42.09 ± 6.13	42.53 ± 5.98	39.70 ± 6.15	40.88 ± 6.06
Systolic blood pressure (mean mm Hg ± SD)	126.07 ± 17.57	126.63 ± 16.69	130.62 ± 16.94	126.35 ± 16.78	126.73 ± 16.91
Diastolic blood pressure (mean mm Hg ± SD)	74.92 ± 9.48	77.41 ± 9.19	74.70 ± 10.97	77.43 ± 10.58	76.83 ± 9.98
High density lipoprotein (mean mmol/L ± SD)	1.25 ± 0.38	1.27 ± 0.39	1.16 ± 0.38	1.43 ± 0.46	1.32 ± 0.43
Low density lipoprotein (mean mmol/L ± SD)	2.55 ± .83	3.00 ± 1.10	2.54 ± .96	3.42 ± .93	3.07 ± 1.04
Total cholesterol (mean mmol/L ± SD)	4.48 ± 1.01	5.32 ± 1.64	4.70 ± 1.10	5.67 ± 1.10	5.29 ± 1.37
Triglycerides (mean mmol/L ± SD)	1.57 ± .82	2.37 ± 2.61	2.26 ± 1.20	1.85 ± 1.13	2.03 ± 1.82
Fasting Plasma Glucose (mean mmol/l ± SD)	5.42 ± .77	8.47 ± 3.26	8.36 ± 3.20	5.33 ± .68	6.82 ± 2.76
Smoking status (%current)	11 (7.6%)	45 (12.7%)	9 (12.0%)	68 (17.6%)	133 (13.8%)

Note. CVD: cardiovascular disease; DM: diabetes mellitus.
ANOVA and chi-squares by disease status are all significantly different, $ps < .05$.

and from .08–25 (mean 6.73 ± 6.30) for participants with cardiovascular disease. As noted, all variables differed significantly by disease status.

Measures

During the telephone screening, participants were asked to self-report whether they had cardiovascular disease or diabetes, and how many months ago they were diagnosed. Data from primary care physician or nurse-practitioner reports were used to confirm disease status. These reports were also used to abstract other parameters needed to compute the 10 year absolute risk for developing cardiovascular disease based on the Framingham-derived global risk assessment algorithm (Grundy *et al.*, 1999; Wilson *et al.*, 1998). The factors used to estimate risk included age, low density lipoprotein, high density lipoprotein, blood pressure, cigarette smoking, and diabetes mellitus. During the site visit, height and weight (to compute body mass index), waist circumference, and blood pressure were assessed.

Physical activity behavior was evaluated in the survey through items from the 1996 Canadian National Population Health Survey (http://www.statcan.ca/english/concepts/nphs/index.htm). Participants were asked to check each activity in which they had participated in the last three months from a list of 20 activities of varying intensities (i.e., walking for exercise, gardening or yard work, swimming, bicycling, dance, home exercise, ice hockey, ice skating, in-line skating, exercise class or aerobics, bowling, baseball or softball, tennis, weight training, fishing, volleyball, basketball, downhill skiing or snowboarding, golfing, and running or jogging). The total number of activities was computed. Frequency and duration were assessed by asking participants the number of times they engage in these activities per week and the number of minutes they spend engaging in these activities per bout, respectively. Lifestyle physical activity was assessed by asking participants the number of hours they spend in a typical week walking or riding a bike to work or run errands.

Physical activity correlates

The survey included an assessment of self-reported physical activity correlates at the sociodemographic and psychosocial level. The sociodemographic data included age, sex, ethnocultural

Table II. Number of Physical Activities (PA), and the Frequency and Duration of Lifestyle Activities by Disease Status

PA Parameter	CVD ($n = 144$)	DM ($n = 355$)	DM & CVD ($n = 75$)	Elevated risk ($n = 390$)	Total ($N = 964$)
Number of activities (mean ± SD)	3.17 ± 1.72*	2.58 ± 1.74*	2.61 ± 1.44*	3.39 ± 2.00*	3.00 ± 1.86
Lifestyle PA frequency (% ≥3 times/wk)	61 (61.6%)	153 (55.0%)	28 (57.1%)	243 (67.3%)	485 (61.6%)
Lifestyle PA duration (% ≥31 min/bout)	93 (67.4%)	189 (57.1%)	37 (55.2%)	247 (65.0%)	566 (61.8%)

Note. CVD: cardiovascular disease; DM: diabetes mellitus.
*$p < .05$.

background, marital status, years of education, work status, and income. Participants were also asked if they were current, past, or non- smokers.

Motivational readiness or stage of change for physical activity was assessed with two items, both scored on a six-point scale ranging from 1-"No, I am not at all ready and I believe it is not important for my health," 2-"No, I am not at all ready but I believe it is important to my heart health" to 6-"Yes, regularly for more than 6 months." This scale corresponds with Prochaska's stages of change (Prochaska and Velicer, 1997) from precontemplation (non-believer and believer) to maintenance (Reed, 1999). The first item queried about moderate-to-vigorous exercise intensity for 20 min 3–5 times per week, and the second item queried about lifestyle activity most days of the week (i.e. keeping active through walking, climbing stairs, cutting grass, shoveling snow, and washing floors). A composite mean score was computed for physical activity stage of change.

Corresponding items were created to assess physical activity efficacy in the domains of moderate-to-vigorous exercise intensity and lifestyle activity most days of the week. Participants were asked to rate their confidence in performing these physical activity behaviors on a five-point Likert type scale ranging from 0-"not at all confident" to 4-"extremely confident" (Reed, 1999). Again, a composite mean score was computed for physical activity efficacy.

Statistical Analyses

Data were cleaned and screened to evaluate statistical assumptions. Statistical analyses were performed with SPSS 14.0. A descriptive examination of the variables was performed, and sociodemographic and clinical differences by disease status were analyzed with chi-square and ANOVAs as appropriate. Logistic regression analysis was used to examine the correlates associated with physical activity frequency. Where significant differences were found, post-hoc non-parametric tests were performed using Games-Howell.

RESULTS

Self-Reported Physical Activity Type, Frequency and Duration

The mean number of activities engaged in over three months are shown in Table II, and ranged from zero to 12. The number of activities differed significantly by disease status ($F(3,955) = 13.67$, $p < .001$). Post-hoc non-parametric Games-Howell tests revealed that participants with cardiovascular disease engaged in a greater range of activities than those with diabetes ($p = .003$), and participants with neither cardiovascular disease nor diabetes engaged in a greater range of activities than those with diabetes ($p < .001$) or those with both cardiovascular disease and diabetes ($p = .001$). With regards to duration per week engaging in lifestyle activity, 28 (2.9%) participants spent more than 20 h, 42 (4.4%) spent from 11–20 h, 110 (11.5%) spent from 6–10 h, 361 (37.7%) spent from 1–5 h, 224 (23.4%) spent less than one hour, and 192 (20.1) participants spent no time doing so in a typical week.

Typical weekly bout duration of lifestyle activity was zero minutes for 192 participants (20.1%), less than 1 h for 224 participants (23.4%), from 1–5 h for 361 participants (37.7%), from 6–10 h for 110 participants (11.5%), from 11–20 h for 42 participants (4.4%), and greater than 20 h for 28 participants (2.9%). Average weekly frequency of lifestyle activity was zero times per week for 83 participants (10.5%), 1–2 times for 219 participants (27.8%), from 3–4 times for 265 participants (33.7%), from 5–6 times for 140 participants (17.8%), and 7 or more for 80 participants (10.1%). A median split was used to create a dichotomous lifestyle physical activity frequency variable of ≤ two times per week versus three or more times per week (Table II).

Table III. Frequency of Stage of Change for Physical Activity, $N = 964$

	Moderate-Vigorous activity 20 min, 3 + times/wk	Planned lifestyle activity most days of the week
Precontemplation – Non-believer	4 (0.4%)	5 (0.5%)
Precontemplation – Believer	101 (10.7%)	50 (5.3%)
Contemplation	76 (8.0%)	50 (5.3%)
Preparation	278 (29.3%)	128 (13.5%)
Action	178 (18.8%)	139 (14.6%)
Maintenance	311 (32.8%)	578 (60.8%)

Physical Activity Motivational Readiness and Self-Efficacy

As shown in Table III, most participants were in the maintenance stage with regard to planned lifestyle activity most days of the week; however they were more frequently in earlier stages with regard to moderate to vigorous physical activity for at least 20 min three or more times per week. Table IV displays the mean physical activity stage of change and self-efficacy scores, and each differed significantly by disease status (readiness for moderate to vigorous activity three times per week $F(3,947) = 5.03$, $p = .002$; readiness for planned lifestyle physical activity most days of week $F(3,949) = 11.27$, $p < .001$; efficacy for moderate to vigorous activity 3 times per week $F(3,957) = 5.56$, $p = .001$; readiness for planned lifestyle physical activity most days of week $F(3,953) = 8.75$, $p < .001$). Games-Howell post-hoc tests were conducted to uncover these differences. Motivational readiness for moderate to vigorous physical activity was significantly lower in diabetic participants than cardiovascular disease participants ($p = .007$) and those with neither condition ($p = .009$). Motivational readiness for planned lifestyle physical activity most days of the week was also significantly lower in diabetes participants than cardiovascular disease participants ($p < .001$) and those with neither condition ($p < .001$). Efficacy for moderate to vigorous physical activity was significantly lower in diabetes participants than cardiovascular disease participants ($p = .01$) and those with neither condition ($p = .03$). Additionally, this self-efficacy was higher among participants with cardiovascular disease only when compared to those with both cardiovascular disease and diabetes ($p < .05$). Efficacy for planned lifestyle physical activity most days of the week was also significantly lower in diabetes participants than cardiovascular disease participants ($p < .001$) and those with neither condition ($p < .001$).

Overall, the composite physical activity stage of change score was 3.88 ± 1.03, and the composite physical activity self-efficacy score was 3.10 ± 1.00. There were no significant correlations among time since diagnosis and motivational readiness or efficacy for those with cardiovascular disease ($r = -.02$, $p = .83$; $r = -.02$, $p = .86$, respectively) or diabetes ($r = -.02, p = .70$; $r = -.09, p = .13$, respectively).

Model of Lifestyle Physical Activity Frequency Correlates

A logistic regression analysis was conducted predicting weekly frequency of lifestyle activity (< vs ≥ three times per week). Analysis was conducted using SPSS LOGISTIC REGRESSION. A test of the full model with all predictors against a constant-only model was statistically reliable ($\chi^2(12) = 51.98$, $p < .001$), indicating that the correlates, as a set, reliably distinguished between those who exercised more frequently than others (Table V). According to the Wald criterion, marital status, work

Table IV. Mean and Standard Deviation of Physical Activity (PA) Motivational Readiness and Efficacy by Disease Status

	CVD ($n = 144$)	DM ($n = 355$)	DM & CVD ($n = 75$)	Neither ($n = 390$)	Total ($N = 964$)
Readiness[a] for Moderate-Vigorous PA 20 min, 3 + times/wk	3.77 ± 1.35*	3.34 ± 1.33*	3.50 ± 1.41	3.64 ± 1.27*	3.54 ± 1.33
Readiness[a] for lifestyle PA most days/wk	4.43 ± 1.00*	3.91 ± 1.37*	4.14 ± 1.24	4.36 ± 1.09*	4.19 ± 1.22
Efficacy for Moderate-Vigorous PA 20 min, 3 + times/wk	3.23 ± 1.15*	2.86 ± 1.29*	2.73 ± 1.41*	3.11 ± 1.11*	3.00 ± 1.22
Efficacy for lifestyle PA most days/wk	3.39 ± 0.92*	2.98 ± 1.18*	3.06 ± 1.20	3.33 ± 0.98*	3.19 ± 1.08

Note. CVD: cardiovascular disease; DM: diabetes mellitus.

*$p < .05$.

[a]Readiness scores range from 1 'precontemplation' to 6 'maintenance'.

Table V. Model of Physical Activity Frequency Correlates, $N = 964$

Variable	β	Wald	p	OR	95% C.I.
Sex	−.066	.162	.688	.936	.679–1.291
Age	.020	3.822	.051	1.020	1.000–1.040
Ethnocultural background	.069	.105	.746	1.072	.704–1.632
Marital status	.383	5.027	.025	1.467	1.049–2.051
Years of education	.005	.022	.883	1.005	.942–1.072
Work status	−.509	7.876	.005	.601	.422–.858
Site – Urban		6.290	.043		
Site – Rural	−.309	2.405	.121	.734	.497–1.085
Site – Northern	−.491	5.762	.016	.554	.342–.897
Smoker	.464	3.864	.049	1.591	1.001–2.527
Disease status – Neither		6.743	.081		
Disease status – CVD	−.308	1.447	.229	.735	.445–1.214
Disease status – DM	−.439	6.182	.013	.645	.456 – .911
Disease status – CVD & DM	−.415	1.575	.209	.660	.346–1.262

Note. CVD: cardiovascular disease; DM: diabetes mellitus.

status, smoking, region, and disease status were significant predictors of lifestyle activity frequency. Post-hoc chi-square analyses on the former three variables revealed that married or partnered participants (64.2%) were more frequently active than those who were not (56.2%; $\chi^2 = 4.63$, $p = .03$), participants who were employed on a temporary or part-time basis (66.9%) were more frequently active than those who were employed full-time (52.1%; $\chi^2 = 16.77$, $p < .001$), and non-smokers (63.8%) were more frequently active than smokers (47.1%; $\chi^2 = 10.65$, $p = .001$). Community type was also significant, whereby northern participants were less frequently active (52.0%) and urban participants were more frequently active (65.2%; $\chi^2 = 7.79$, $p = .02$). With regard to disease status, participants with diabetes were less frequently active, with a trend towards more frequent activity in high-risk participants without established cardiovascular disease or diabetes. Finally, there was a trend toward increased physical activity frequency among participants of older age ($t = -4.49$, $p < .001$).

DISCUSSION

Physical inactivity is prevalent and threatens primary and secondary prevention of chronic diseases, yet factors influencing physical activity behavior in medical populations (particularly those with diabetes mellitus) have been neglected in the literature (Dunn, 1993; Mutrie, 1999; Swift *et al.*, 1995). This study explored the multi-level correlates of physical activity, including the theoretical constructs of motivational readiness and self-efficacy, in a diverse community sample of people with cardiovascular disease and diabetes mellitus. Results revealed that participants engaged in an average of three lifestyle activities, and over 60% of participants engaged in these activities more than 3 times per week for more than 30 min per bout. While this is quite high when compared to data showing the high degree of inactivity (Dubbert, 2002), these results reflect lifestyle activities of varying intensities, which have also proven beneficial (Duncan *et al.*, 2005; Franco *et al.*, 2005). Motivational readiness and self-efficacy were more favorable for lifestyle versus vigorous-intensity activity, suggesting that maintenance of physical activity would be more successful through the promotion of lesser-intensity activity.

Results discouragingly revealed significantly less physical activity behavior among diabetes participants in adjusted analyses, which could be reflected in their decreased physical activity readiness and self-efficacy. While people with diabetes have additional physical activity considerations with regard to glucose levels, poor circulation, foot care, and perhaps obesity, which those with cardiovascular disease or without diabetes may not have, nevertheless lifestyle activity of the frequency and intensity studied herein is universally recommended based on evidence of risk reduction. While there are a paucity of studies stratifying risk factor data by diabetes status, these results corroborate those of Smith *et al.* who demonstrated significantly lower daily energy expenditures in a population-based community sample of older participants with diabetes versus normoglycemics (of which 22% had cardiovascular disease (Smith *et al.*, 2002)).

This lower degree of physical activity behavior, readiness, and efficacy among diabetes participants may be a manifestation of the complex self-management regimen in the areas of diet, exercise, foot care, blood glucose monitoring, and medication. This may lead to 'diabetes burnout' (Snoek, 2002) due to repeated failure to successfully achieve ongoing glucose control. An international survey demonstrated a high degree of denial and fatalism among people with diabetes, where 40% perceived that complications will arise no matter what preventive measures they take (Henrichs, H, and International Diabetes Federation-Europe and Lions Clubs International Foundations., 2002). Considering we showed no difference in physical activity based on time since diagnosis, this suggests that the overall burden of self-management in multiple domains may be contributing to inactivity, rather than burnout over time. Previous research has suggested that patients with diabetes do perceive glycemic control and prevention of complications as motivation to engage in physical activity, but identify diabetes -specific physical activity barriers such as fear of reactions from hypoglycemia (Swift *et al.*, 1995).

Other explanations for the lower degree of physical activity behavior in diabetes patients may include lack of physical activity recommendations from health care providers (Marsden, 1996), who may be targeting other factors for risk reduction. Another explanatory construct could be physical activity history, considering the evidence that activity history during adulthood is a significant correlate of physical activity (Clark, 1999). Diabetes develops in the presence of physical inactivity (American Diabetes Association. 2002; Duncan *et al.*, 2003), as does cardiovascular disease (Yusuf *et al.*, 2004), therefore we cannot speculate that participants with diabetes are more likely to have a history of sedentariness causing inactivity than other participants. Finally, given the significant sociodemographic and anthropometric differences in the diabetes versus non- diabetes groups, it is possible that factors such as obesity for example are playing a role. The issue of obesity in particular is a complicating one, as it is for all studies examining diabetes, in that direction of causality cannot be determined (i.e., is it obesity which leads to lower activity or lower activity which leads to obesity). To address this issue, we ran another regression model including body mass index, and the results revealed consistent correlates, with body mass index reaching significance as well. The level of significance for diabetes status fell slightly to $p = .056$. Moreover, even though the participants with diabetes had a significantly higher mean body mass index of 32, those without diabetes also had a high mean body mass index of 29, suggesting that obesity per se is not explaining the effect. Further research is necessary to test these speculations, and gain a better understanding of the reasons for inactivity among people with diabetes.

Consistent with previous research (Trost *et al.*, 2002), region of residence and smoking behavior were also significant correlates of physical activity. In particular, our results revealed lower physical activity frequency among northern Ontario-residing participants and greater frequency among urbanites. This could be related to environmental factors such as colder weather, fewer daylight hours, and more homogeneous and lower density land use which serve as a deterrent to walking or biking from home to work or to run errands (Humpel *et al.*, 2002; Frank *et al.*, 2004) seen in northern areas of Canada and other northern nations such as Scotland (Pageot, 1987; Stephens and Caspersen, 1994). Much research now corroborates that mixed land use (i.e. incorporating both residential and commercial properties), and higher density communities with public transportation (i.e. walking to and from stops or stations) as found in urban environments are related to greater physical activity. In fact, these environmental influences on physical activity are addressed in the American Heart Association's recent lifestyle recommendations (Lichtenstein *et al.,* 2006). Previous research is less consistent in findings related to marital and work status (Booth *et al.*, 2000). Our results suggest that in this older and diverse community sample at elevated risk, being married or partnered is related to greater physical activity frequency, as is non full-time work status. This could be due to the greater time availability to devote to such activities. Contrary to previous research (Trost *et al.*, 2002), sex, ethnocultural background, and education level were unrelated to physical activity frequency in adjusted analyses.

The limitations of this study include the cross-sectional design, self-report of physical activity behaviors, unknown generalizability, and differences in participant characteristics by disease status. With regard to the former, the study design precludes any inferences of causality or direction of effect. Second, the self-report of physical activity could have led to social desirability biases and thus possible over-reporting of physical activity behavior. However, to the extent that over-reporting may have occurred, it is likely to have happened across groups, and therefore likely not to have contributed to group differences. Third, we were unable to discern the generalizability of our sample, and had to exclude potential participants due to lack of physician confirmation of risk factor status, and unwillingness to participate in the larger intervention. Moreover, the generalizability of our finding regarding the environmental correlate of living in a northern region, would only be generalizable to other northern countries. Finally and most centrally, there were significant differences between disease subgroups on all sociodemographic, anthropometric, and physiological variables examined. For instance, the participants with diabetes were more often female, less likely to be married, and less likely to be retired. Therefore, we cannot rule out the possibility that another variable may explain the relationship between disease status and physical activity frequency and efficacy, although we attempted to control for many sociodemographic variables in our model. Moreover, these differences likely reflect typical characteristics seen in these populations. To address these limitations, future prospective research is required with a matched sample of diabetes and cardiovascular disease participants, which utilizes objective measures of physical activity such as activity monitors. Assuming that subsequent research corroborates these findings, future research should also investigate what factors (e.g., burnout, denial, or fatalism) may play a role in lower physical activity behavior among people with diabetes versus cardiovascular disease, or other conditions such as cancer.

In conclusion, people with diabetes mellitus as well as those living in northern regions engage in less physical activity. Although limited randomized controlled trials of physical activity interventions among people at high risk for cardiovascular disease, including cognitive-behavioral techniques and motivational interviewing (Dishman and Buckworth, 1996; Hancock *et al.*, 2005; Marcus *et al.*, 1992; Marcus *et al.*, 1998; Cowan *et al.*, 1997), have shown promising results, we clearly need a more accessible approach to primary and secondary prevention to successfully reach northern residents and meet the needs of people with diabetes. Recent proliferation of chronic disease management programs, such as combined diabetes education and cardiac rehabilitation programs, may provide a useful forum for such interventions, particularly when they reach non-urban populations. Attention to environmental correlates of physical activity behavior and how to overcome them through the use of telephone or home-based interventions is warranted.

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