Profiles of Smokers and Non-smokers with Type 2 Diabetes: Initial Visit at a Diabetes Education Centers

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**ABSTRACT**

Aims: This study explores differences in psychosocial, behavioral and clinical characteristics among smoking and non-smoking individuals with diabetes attending diabetes education centers (DEC).

Methods: A questionnaire was administered to 275 individuals with type 2 diabetes attending two DECs between October 2003 and 2005. The participants’ characteristics were analyzed and multivariable linear and ordinal regressions were performed to adjust for variables correlated with smoking.

Results: Findings revealed that smokers, compared to non-smokers, had lower outcome expectations of the benefits of self-management, lower diastolic blood pressure, followed their recommended diet, and tested blood glucose levels less often than non-smokers. Smokers also had lower intentions to use resources outside and within the DEC.

Conclusions: Results demonstrate poorer self-care behaviors among smokers compared to non-smokers and further suggest cognitive and behavioral differences between smokers and non-smokers regarding participation and attitudes towards self-management practices. These findings identify issues that need to be addressed in diabetes self-management programs to allow for more effective interventions tailored to the healthcare needs of this specific population.

**KEYWORDS:** smoking, type 2 diabetes mellitus, self-management, education services

# INTRODUCTION

Smoking is one of the leading causes of premature mortality worldwide. Smoking has been linked to an increased risk of heart disease, neurological diseases, infertility and various cancers, and has a negative impact on the global economy in terms of increased health care spending [1]. Studies have shown that the prevalence of smoking is similar in individuals with diabetes compared to the general population, ranging from 25 to 28% [2,3]. Smoking is shown to have detrimental effects on glucose [3] and lipid metabolism [4,5], which contributes to complications [4]. Smokers with diabetes, however, are at a greater risk of a reduced life expectancy [6,7] and at an increased risk for macrovascular complications, particularly cardiovascular mortality [6,8,9], and microvascular complications, such as nephropathy [10,11], neuropathy [12,13], and retinopathy [14] compared to non-smokers. Nevertheless, only a few studies have examined smokers’ and non-smokers’ attitudes and behaviors toward diabetes management, and how these differences may influence their risk of complications. Smokers with diabetes are less likely to regularly check their blood glucose levels and engage in daily physical activity, and more likely to report fair or poor health and feel more depressed compared to non-smokers [15]. Furthermore, smokers are less likely to have a regular diabetes care provider [15],attend a hospital clinic or see a diabetes nurse [16], and have fewer medical visits, foot checks, eye exams and dental visits [15]. The EPIC-Norfolk study examined the role of smoking and dietary factors in glycemic control; the authors noted that degree of smoking exposure was correlated with HbA1c levels, and that smokers consumed more saturated fat, and less fiber and vitamin C compared to non-smokers [17].

Given the evidence suggesting differences in diabetes self-care between smokers and non-smokers, this study aims to comprehensively explore cognitive, psychosocial, behavioral and clinical characteristics among smoking and non-smoking individuals with diabetes at the time of their initial visit to a diabetes education center (DEC). Identifying these differences will provide direction on how to customize counseling and education for smokers in clinical practice, better facilitate diabetes self-management activities and smoking cessation.

# METHODS

## Research Participants

Research participants were recruited from two large DEC’s within the Greater Toronto Area in Ontario, Canada, between October 2003 and October 2005. Recruitment took place on all clinic days at two sites during the study intake period to reflect a census sample representative of the centers’ patients. All patients who met the eligibility criteria during the recruitment window were approached. Patients who were 18 years of age or older, diagnosed with type 2 diabetes, responsible for self-managing their diabetes, new to the center or re-referred to the center after a two-year period, free from conditions known to influence participation (i.e., pregnancy or receiving hemodialysis), not anticipating a move outside the community within the next year, able to speak and read English, and able to provide informed consent and answer a questionnaire were eligible for inclusion. Of the 1,258 patients approached, 511 patients were eligible, of whom 281 consented, giving a participation rate of 55%. During the study period, 13 patients became ineligible because their diagnosis of diabetes was unconfirmed, had moved out of the city or passed away; therefore, the study sample comprised 268 participants.

## Research Design

The study used a cross-sectional design. The research assistant screened all scheduled patients for that day and determined eligibility based on our inclusion/exclusion criteria. The research assistant placed a research script that described the research project for the educators to read to each patient during the initial visit, in all patient medical records that met the a priori eligibility criteria. During the visit, each eligible patient had the opportunity to be informed about the project and either agreed or disagreed to participate. Those who agreed were directed to the research assistant who was onsite. A questionnaire was administered to patients immediately after their visit to collect sociodemographic, psychosocial and behavioral information. Patients were also asked to take a hemoglobin A1c test (if their most recent test was not provided to the DEC by the patient’s referring physician) following their first visit to measure glycemic control. Patient information including disease-related, clinical and DEC utilization variables extracted from the centers’ medical records.

 **Descriptive Variables and Measures**

Sociodemographic variables collected were age, sex, educational attainment, work status, household income and marital status. Cognitive variables measured were: outcome expectations of the usefulness of diabetes education services on self-management behaviors and on future health outcomes (Diabetes Education Outcome Expectations Scale); self-efficacy in overcoming barriers to using diabetes education services and communication with diabetes educators (Diabetes Education Self-Efficacy Scale); intentions to use resources within and outside the DEC; and intentions to adopt self-management recommendations (Diabetes Education Intention Scale). Scales pertaining to the cognitive variables were developed by the research team and show good psychometric properties based on internal reliability and factor structure, and moderate validity with similar type scales (currently unpublished). Psychosocial factors measured were depressive symptoms during the previous 2 weeks (21-item Beck Depression Inventory [BDI-II]) [18,19]; diabetes-specific and general social support (Perceived Social Support Component of the Diabetes Care Profile [DCP] [20] and the Medical Outcomes Study [MOS] Social Support Survey [21], respectively); and various aspects of patient satisfaction with services (General Practice Assessment Questionnaire [GPAS][22]). Questions regarding patients’ access to services included “*How do you rate the hours the DEC is open?”* and “*How do you rate the time it took to book your first DEC appointment?”* Further, questions about patients’ continual access to DEC services included “*Do you think the DEC’s hours of operation are a problem in allowing you to continue to use the services*?”, “*Do you think the hours and days of the group education program are a problem for you to attend?*” and “*Do you think the length of time you wait to get an appointment is a problem for you to continue using the services?*" Self-care activities, such as diet, exercise, foot care and blood sugar testing, performed in the past seven days were measured using the Summary of Diabetes Self-care Measure [23]. Disease-related variables included months living with diabetes, family history of diabetes, previous diabetes education, total number of diabetes-related symptoms and health conditions, smoking practices, type of diabetes management, and diabetes knowledge measured with the Diabetes Knowledge Questionnaire (DKQ) using a three-point scale of *no*, *yes*, and *not sure* [24]. All of the above mentioned scales have been shown to possess reliable and valid psychometric properties [25,26,27,28]. Clinical variables collected were body mass index (BMI), HbA1c (measure of glycemic control over the past three months), high-density lipoproteins (HDL), total cholesterol-to-HDL ratio, triglycerides, low-density lipoproteins (LDL), and blood pressure. For the HbA1c assays, all lab work was conducted in laboratories that have certification corrected for the Diabetes Control and Complications Trial (DCCT) Reference Method [29].

## Statistical Analyses

The outcome variable, smoking status, classified participants into smokers and non-smokers, based on the self-reported question, *“Do you smoke?”* Statistical analyses were conducted using SPSS 12 (SPSS Inc., Chicago, Illinois, 2003). The mean and standard deviation (for continuous variables) or the median and inter-quartile range (for skewed continuous variables), and the number and percentage of study participants were reported for each descriptive variable by smoking status. A T-test or Mann-Whitney test analyzed continuous variables and a Chi-square test analyzed categorical variables, with a statistical significance at a p-value of 0.05 or less. We controlled sociodemographic variables that are known to be highly correlated with smoking status (sex, age, education, employment status and household income) - bivariate associations were tested using multivariate linear regression for continuous variables, and multivariate ordinal regression for ordinal and skewed continuous variables with results presenting the odds ratio (OR) and p-value. Body mass index (BMI) was also controlled for in the multivariate linear regression for diastolic blood pressure.

# RESULTS

From the 275 study participants, 235 individuals stated they were non-smokers and 40 (14.5%) stated they were smokers. Smoking participants smoked an average of 13.6 cigarettes daily, ranging from 1 to 45 cigarettes each day. Almost half of the study population was employed full or part time (49%), over 46% had a total household income of less than $39, 000, and approximately 72% of participants had a family history of diabetes. Almost 59% were born in North America, followed by Europe (19%), Asia (13%), and South America or Africa (9%), and 84% spoke primarily English at home (see Table 1).

On the bivariate level, smokers with diabetes had lower outcome expectations of the benefits of self-management activities (p=0.031) and were less likely to adopt diet recommendations over the past seven days (p=0.011). Following diet recommendations was based on three specific diet activities. Specifically, smokers were significantly less likely to evenly space carbohydrates throughout the day (p=0.016) and marginally less likely to eat five or more servings of fruits and vegetables compared to non-smokers (p=0.053). No differences were noted between smokers and non-smokers in consumption of high fat foods, like red meat or cream/cheese products. Smokers were also less likely to regularly test their blood glucose levels in the previous seven days than their non-smoking counterparts (p=0.038). Furthermore, they reported lower intentions to use diabetes-related resources outside the DEC (p=0.004), and showed less interest in continuing to use DEC services after their initial visit (p=0.049). A marginally significant association was observed as smokers reported less professional healthcare team diabetes support (p=0.066) compared to non-smokers. Smokers were found to have significantly higher triglycerides (p=0.014) and lower diastolic blood pressure (p=0.015) (see Table 1).

After adjusting for sociodemographic variables in a multivariate linear analysis, smoking status remained a significant predictor of following dietary recommendations less often (β = -0.466, p-value = 0.033), and lower diastolic blood pressure (β = -3.891, p-value = 0.019) and blood glucose testing (β = -0.979, p-value = 0.050) (see Table 2). The continuous independent variables were normally distributed. The multivariate ordinal regression analysis controlling for sociodemographic variables demonstrated that smoking status predicted lower outcome expectations of the benefits of self-management (OR = 0.515, p-value = 0.044), lower intentions to use resources outside the DEC (OR = 0.410, p-value = 0.005) and lower intentions to use resources within the DEC (OR = 0.501, p-value = 0.027) (see Table 2). Although marginally significant, perceived support from diabetes healthcare teams remained slightly lower among smokers (OR = 0.834, p-value = 0.058).

# DISCUSSION

The findings suggest that smokes are less likely to adopt nutrition recommendations; specifically smokers are significantly less likely to equally distribute carbohydrate consumption throughout the day. The EPIC-Norfolk cohort study conducted between 1995-1998 reports poorer eating behaviors among smokers compared to non-smokers or former smokers with diabetes, including the consumption of more dietary fat and less dietary fiber [17]. Smokers are also less likely to regularly test their blood glucose levels. The literature corroborates our finding as smokers report lower blood glucose testing [16] or are less likely to check their blood glucose levels more than once a week [15]. Not surprisingly, smokers with diabetes have lower outcome expectations of the benefits of self-management activities on their health.

Another important aspect of diabetes self-management is the use of diabetes resources and ongoing contact with the healthcare team in order to ensure the care plan is appropriate and effective. Although there was no difference in satisfaction with and access to DEC services by smoking status, findings suggest that smokers have lower intentions to use diabetes resources within and outside the DEC, even after adjusting for sociodemographics. In a survey of individuals with diabetes, Gulliford et al. [16] report that current smokers are less likely to attend a hospital clinic, and both smokers and ex-smokers are less likely to have visited a diabetes nurse in the last year. Findings by Solberg et al. [15] suggest fewer medical visits, foot checks, eye exams and dental check-ups, and a lower likelihood of having a regular diabetes care provider among smokers [30]. While marginally significant, smokers in our study also report lower levels of support from their diabetes healthcare team. It may be that smokers misinterpret healthcare professionals’ support as pestering if the focus is on smoking cessation rather than on other self-identified healthcare needs of the patient. Within the general population, similar results have been noted with smokers showing poorer self-care behaviors compared to non-smokers across almost all health behaviors, including lower fruit and vegetable consumption, lower exercise levels and fewer physical check-ups [31]. It is important to note that actual behavioral change is predicted by cognitive intention but also ultimately determined by physiological and environmental factors.

The only clinical difference in this study was lower diastolic blood pressure among smokers compared to non-smokers, a relationship that remained significant after adjusting for BMI and sociodemographic variables. Both groups (smokers at 125/74 mmHg and non-smokers at 128/78 mmHg), however, were below target for those with diabetes (> 130/80 mm Hg) [32]. A study conducted by Masulli et al. [33] with non-diabetic men supports this finding, reporting significantly lower diastolic blood pressure among smokers compared to non-smokers and ex-smokers, possibly influenced by variations in the use of anti-hypertensive medications [33] and a more aggressive approach to hypertension management by physicians given the greater risk of cardiovascular events among smokers with diabetes.

Our study focuses on the differences present between smokers and non-smokers upon initial visit to DECs in a larger metropolitan city in Canada. However, it is important to recognize that similarities were also noted between these two groups. Our study reported no differences in a number of sociodemographic variables, diabetes knowledge, family history of diabetes, and several clinical variables including BMI, HDL, LDL and HbA1c. The literature reports similar findings with no difference in certain sociodemographic variables, self-reported social support, some self-care behaviors and cholesterol levels [15,34,35].

This study demonstrates significant disparities between smokers and non-smokers in how they view and participate in diabetes self-management activities. The fact that smokers with diabetes have poorer health care behaviors has important clinical implications. Smokers with diabetes may benefit from additional intervention and support aimed at improving health behaviors. It may be useful to allow patients to determine their own behavioral change goals, and recognize that only they can identify what areas of their lives are most threatened by diabetes or smoking. Making their own self-management decisions will result in more meaningful outcomes [36]. Focusing on one behavior change at a time may improve health outcomes and self-efficacy in other health-promoting behaviors. For instance, interventions aimed solely at exercise demonstrate greater reduction in glycemic control compared to interventions targeting multiple health behaviors among individuals with diabetes [30].

In exploring the relationship between diabetes and smoking, one study concluded that the use of a ‘glucose equivalent’ in a clinical setting could help with diabetes management among smokers [37]. The glucose equivalent quantifies the increase in blood glucose levels that corresponds to smoking in individuals with diabetes. Glucose equivalents may be a valuable tool to instill greater motivation for smoking cessation by demonstrating the threat smoking poses to the blood glucose levels [37]. Those who quit smoking may be more likely to modify other self-care behaviors and adopt a healthier lifestyle as a result of increased self-efficacy and greater sense of health. Therefore, it may be beneficial for educators to engage patients in selecting and focusing on one area of behavior change, and then systematically extend behavior change goals to include smoking cessation.

Murphy and Becker’s Theory of Rational Addiction states that consumption of a harmful, addictive product increases the impetus for its future consumption, irrespective of the harm associated with future consumption [38,39]. Therefore, if the benefits of smoking outweigh the associated long-term health risks, effective healthcare strategies aimed at smokers should target this cognitive-behavioral system. Further research is required to examine the role of addiction in perpetuating addictive behavior and the effect on health behaviors of smokers with chronic diseases. Smokers are inherently at a greater risk of diabetes complications; collaborative partnership between DECs and smoking cessation programs may enable more effective healthy self-care behaviors.

This study has several limitations. Because the outcome variable was based on the self-reported question “Do you smoke?” and does not distinguish between current, past or never smokers, as well as cigarette, pipe and cigar smokers, our analyses are limited and cannot identify characteristics of the various types of smokers or former smokers. In addition, the response rate is somewhat low, which may be because our questionnaire (approximately one hour) was administered following an hour-long visit with a diabetes educator It has been noted in the literature that smokers with diabetes are more likely to under-report their smoking behaviors [40]. Smokers may feel it is socially unacceptable to admit to smoking or fear of reproach or humiliation because of their diabetes. Our sample had a relatively low ratio of smokers to non-smokers, 0.17. However, the literature reports varying ratios of smokers to non-smokers across studies ranging from 0.14 [17], 0.17 [31], 0.19 [16], 0.60 [42] to 1.33 [11]. Statistics Canada reports that 16.5% of all Canadians aged 12 years and older were current smokers in 2005 [41], a number similar to the prevalence of smokers in our study (14.5%). Study participants were recruited from two DECs. Individuals with diabetes are often referred to a DEC once they are newly diagnosed, whenever a challenge in achieving metabolic targets is experienced, or a when manifestation of a diabetes complication or a major change in medical therapy is initiated that requires enhanced diabetes self-management skills, as in insulin initiation. Therefore, our results should be generalizable to similar clinical populations within DECs and not necessarily to all with diabetes. Some of our cognitive variables examined in our study were measured using new scales that are currently unpublished. Our sample size may have restricted the power of our analysis to detect differences between smokers and non-smokers. Future research to further investigate the impact of cognitive, behavioral and clinical factors on health outcomes among smokers and non-smokers with diabetes in a prospective study with a larger sample size is needed in order to confirm our study results. Moreover, research is needed to identify effective treatment strategies aimed at improving diabetes self-management in smokers with diabetes.

This study revealed several differences between smokers and non-smokers and further identified concepts applicable to diabetes self-management interventions for healthcare professionals. At the present, we have limited knowledge on effective strategies targeted at smokers with diabetes. Further research to identify barriers to self-care activities, such as the use of diabetes related healthcare services and resources, can direct strategies to make such resources more appealing and appropriate to meet the needs of smokers.

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