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Older adults' beliefs about the timeline of type 2 diabetes and adherence to dietary regimens

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Abstract

The common-sense model posits that behavioural coping with illness is shaped by a complex combination of individuals' abstract and concrete beliefs about their illness. We investigated this theoretical assumption in a study of 116 older adults diagnosed with type 2 diabetes who completed in-person interviews at baseline and six and twelve months later. Specifically, we examined 1) the interaction of patients' abstract and concrete beliefs about the timeline of their diabetes as a predictor of change in adherence to a healthy diet and 2) whether these interactive effects differ among male and female patients. Abstract timeline beliefs were conceptualized as those pertaining to disease duration; concrete timeline beliefs were conceptualized as those pertaining to variability of disease symptoms (i.e., symptoms are stable versus fluctuating). As predicted, duration beliefs were positively associated with improvement in adherence among patients who viewed disease symptoms as stable, but not among those who viewed symptoms as variable. When gender was considered, these interactive effects were observed among male (but not female) patients. Findings revealed that the behavioural effects of men's abstract knowledge about their diabetes were conditioned by their concrete representations of the disease, suggesting a bottom-up process of influence with implications for intervention.

Keywords

illness beliefs; common-sense model; type 2 diabetes; adherence; gender

According to the common-sense model of self-regulation (CSM), individuals faced with illness develop mental representations of, or beliefs about, their illness that both define the condition and guide the ways in which they respond to and manage it (H. Leventhal, Brissette, & E. Leventhal, 2003; H. Leventhal, Nerenz, & Steele, 1984). A key assumption of this model is that illness beliefs operate on two distinct levels: an abstract level based on semantic knowledge (e.g., labelling a disease as chronic or acute) and a concrete level based on perceptual experience (e.g., physical symptoms). These two levels of illness beliefs are theorized to interact with one another to help determine a person's emotional and behavioural responses to a health threat (H. Leventhal et al., 2003). Although a substantial

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body of research has demonstrated the importance of illness beliefs to ways in which patients react to and behaviourally cope with disease (see Hagger & Orbell, 2003 for review), little research attention has been given to the distinction between abstract and concrete illness beliefs or their assumed interactive effects. The overall purpose of the current study was to investigate this theoretical assumption among older men and women diagnosed with type 2 diabetes mellitus.

We examined the moderating effects of older adults' concrete beliefs about their type 2 diabetes on the relationship between their abstract diabetes beliefs and disease management behaviour. In particular, we focused on abstract and concrete beliefs about the timeline of type 2 diabetes. Given that patients often have difficulty comprehending the long-term, continuous nature of chronic conditions and their treatment demands, timeline beliefs have important implications for the management of chronic disease (e.g., Halm, Mora, & Leventhal, 2006). Of secondary interest to the current study were potential gender differences in the associations between timeline beliefs and disease management.

The CSM posits that individuals' mental representations of illness are "bi-level" in nature (H. Leventhal et al., 1997). The abstract, or conceptual, level is represented by labels that identify and describe a condition (e.g., the idea that one has had a stroke, knowledge that a cold is "acute" or that cancer is "in remission"); the concrete level is perceptual in nature and is based on one's experience of symptoms or physical sensations (e.g., pain, fatigue, dizziness) (H. Leventhal et al., 1984; 1997). Theory suggests that abstract and concrete representations can interact in two ways. One possibility is that abstract beliefs about an illness exert a top-down influence on a person's interpretation of somatic sensations (H. Leventhal et al., 2003). For example, a person experiencing chest pain and nausea may incorrectly interpret those symptoms as indigestion rather than a heart attack if nausea is not part of that person's concept of what a heart attack entails. A second possibility is that concrete sensations have a bottom-up influence on one's abstract representations of disease (H. Leventhal et al., 2003). For instance, an individual with hypertension who knows objectively that the condition is asymptomatic may nonetheless take medication only when experiencing "symptoms" (e.g., headache) perceived to be indicative of high blood pressure (Meyer, H. Leventhal, & Gutmann, 1985).

These two types of interactions illustrate the possibility of inconsistency between abstract and concrete illness beliefs (H. Leventhal et al., 1984); the latter example, in particular, demonstrates how such inconsistencies could adversely influence a patient's adherence to treatment regimens. In the context of chronic health conditions, which affect 80% of adults aged 65 and over (Centers for Disease Control and Prevention [CDC], 2011a), it may be especially important to understand inconsistent beliefs about the timeline of illness. Chronic conditions such as diabetes require constant, long-term adherence to treatment recommendations, and failure to understand the chronic and continuous nature of an illness and the associated need for care could lead to serious health consequences.

Additionally, timeline beliefs encompass two independent dimensions that well represent the dual (i.e., abstract and concrete) nature of the CSM. *Disease duration beliefs* refer to whether the disease is perceived as acute or long-lasting. These beliefs involve expectations of the future course of the disease, and thus reflect the abstract level of representations of illness timeline. In contrast, *symptom variability beliefs* refer to whether disease symptoms are perceived to be stable or fluctuating over time (Moss-Morris et al., 2002). As these beliefs stem from one's somatic experience of a disease, it is reasonable to assume that they reflect the concrete level of illness representations. Beliefs about disease duration and symptom variability could be at odds if a person knew his or her disease to be chronic but experienced symptoms only some of the time. To gain insight into the possible implications

of such a combination of timeline beliefs for older adults' management of diabetes, we review research on the independent effects of each belief across multiple disease contexts.

Belief in a long disease duration appears to facilitate better behavioural management of chronic disease, perhaps because individuals who believe that an illness is long-lasting also perceive it as more serious or severe. In past research, patients who viewed their condition (coronary heart disease, asthma, hypertension) as chronic were more likely to be adherent with treatment regimens (Byrne, Walsh, & Murphy, 2005; Halm et al., 2006; Meyer et al., 1985). Studies of patients with diabetes have sometimes failed to find a similar association between duration beliefs and adherence, most likely because of the relatively small proportion of patients who view diabetes as an acute condition (e.g., Barnes, Moss-Morris, & Kaufusi, 2004; Griva, Myers, & Newman, 2000; Paschalides et al., 2004); nonetheless, there is some evidence that believing diabetes to be chronic is associated with better disease management behaviour (Hampson, Glasgow, & Toobert, 1990; Searle, Norman, Thompson, & Vedhara, 2007).

In contrast to the adherence-promoting effects of duration beliefs, beliefs that the symptoms of a disease are variable (i.e., come and go) tend to discourage or inhibit disease management. Patients with chronic illness, including those with type 2 diabetes, who perceive their condition as fluctuating or episodic have been found to adhere less consistently to treatment recommendations, compared to patients who view their disease as a stable condition (Barnes et al., 2004; Halm et al., 2006; Mann, Ponieman, H. Leventhal, & Halm, 2009; Meyer et al., 1985). Perhaps these patients fail to adhere on a regular basis because they believe that symptoms represent the disease itself and, thus, that disease management behaviours are not needed when symptoms are absent (e.g., H. Leventhal et al., 2003; Meyer et al., 1985).

Given their differential associations with disease management behaviours, certain combinations of disease duration beliefs and symptom variability beliefs may send conflicting messages regarding the need for continuous treatment adherence. Though the CSM posits that both top-down and bottom-up processes of influence are possible, Leventhal has suggested that concrete representations may have more influence on one's actions than does abstract knowledge about a disease (H. Leventhal, Diefenbach, & E. A. Leventhal, 1992). Thus, even when patients hold adherence-promoting beliefs about a disease's timeline at the abstract level (i.e., "My disease is chronic"), their concrete symptom experience may alter their disease management behaviours. This major assumption of the CSM, however, has received little empirical attention.

Objectives

Our study addresses an important gap in the literature on illness representations by examining whether older adults' beliefs about the variability of their diabetes symptoms alter the way in which their beliefs about disease duration relate to treatment adherence over time. Diabetes provides an excellent opportunity to investigate the merits of this assumption of CSM theory among older adults. Type 2 diabetes is a chronic condition that requires constant management, even when patients are asymptomatic, and its incidence increases dramatically with age (Gonder-Frederick, Cox, & Ritterband, 2002). Nearly 27% of Americans aged 65 or older have diabetes, and the vast majority of these cases are type 2, rather than type 1 (CDC, 2011b).

In order to manage diabetes, patients must engage in a complex set of behaviours performed on a daily basis. One of the most crucial aspects of this daily regimen is adherence to a healthy diet, as proper dietary management can help prevent or delay symptoms and long-term complications associated with the disease (American Diabetes Association, 2008).

Despite its importance, many patients find adhering to the strict diet to be the most difficult aspect of managing their diabetes, and compliance with dietary recommendations remains less than optimal (Green, Bazata, Fox, & Grandy, 2007; Woodcock & Kinmonth, 2001). Furthermore, adherence to a healthy diet may be especially difficult for older adults because it often requires changes to well-established eating routines and preferences (e.g., Nestle et al., 1998). Accordingly, we chose to focus on older adults' dietary adherence as a critical indicator of their behavioural management of diabetes.

Our study had two major aims. The first aim was to examine change in older patients' adherence to a healthy diet as a function of their beliefs about the duration and symptom variability of type 2 diabetes (hereafter referred to as duration beliefs and variability beliefs, respectively). Based on CSM theory, we hypothesized that patients' variability beliefs would condition the way in which their duration beliefs related to change in dietary adherence. Specifically, we predicted that among patients who believed their diabetes symptoms to be less variable (i.e., more stable), duration beliefs would be *more* strongly related to improvement in dietary adherence over time. In contrast, we predicted that among patients who believed their diabetes symptoms to be more variable (i.e., less stable), duration beliefs would be *less* strongly related to improvement in dietary adherence (e.g., Barnes et al., 2004; Halm et al., 2006; Searle et al., 2007).

The second aim of our study was to explore the interaction of abstract and concrete timeline beliefs as a function of gender. Previous research has rarely considered whether the associations between illness beliefs and illness management differ among men and women, and the existing findings are inconclusive. One study found that certain beliefs about illness were stronger predictors of diabetes management behaviours for older women than for older men; a subsequent study of middle-aged and older adults, however, found no gender differences in patients' reactions to beliefs about diabetes (Hampson, Glasgow, & Foster, 1995; Hampson, Glasgow, & Strycker, 2000). Given these inconsistent findings, we included gender as an exploratory component in our analyses and investigated whether the hypothesized interactive effects of duration beliefs and variability beliefs differed among male and female patients.

Design

Participants

Data used for this study are part of a larger three-wave panel study investigating disease management among older adults with diabetes and their spouses (Iida, Stephens, Rook, Franks, & Salem, 2010). Participants in this larger study were married couples in which one partner (the patient) had been diagnosed with type 2 diabetes for at least one year and the other partner (the spouse) did not have diabetes. Brochures describing the study were placed in medical offices, diabetes education clinics, and senior citizen centres, and advertisements were published/broadcast in commercial media. Interested couples called the research office using a toll-free number and were screened for eligibility. To be eligible, patients had to have a primary medical diagnosis of type 2 diabetes, be at least 55 years of age and in a marriage or marriage-like relationship, reside in the community, and have received in the previous three months a recommendation from a health care provider to make dietary improvements. In addition to not having diabetes, spouses were required to be living in the same household as the patient.

A total of 235 couples were screened for eligibility. Of these, 58 couples (24.6%) were not eligible to participate. The most frequent reasons for ineligibility were that both spouses had diabetes (N= 17) and the patient was younger than 55 years of age (N= 12). After initial contact, some eligible couples (N = 17) could not be reached. An additional 31 eligible

couples (17.5%) declined to participate; the primary reason given for not participating was lack of time or interest ($N=13$). The baseline sample consisted of 129 couples, yielding a response rate of 72.9% for eligible couples.

Procedures

All procedures were approved by the appropriate Institutional Review Board, and written informed consent was obtained from each participant prior to baseline data collection. Structured in-home interviews were conducted separately with patients and spouses at three time points: baseline (T1), six months after baseline (T2), and twelve months after baseline (T3). Five couples left the study by T2, and an additional seven couples left by T3, yielding an attrition rate of 9.3%. Reasons for attrition included death or illness ($N = 4$), lack of time ($N = 2$), and inability to contact ($N = 1$).

Interviews were designed to assess both individual- and couple-level processes relating to diabetes management. Thus, patients (and spouses) responded to items pertaining to their individual experiences with diabetes management, as well as to items relating to diabetes and the marital relationship. Given the theoretical focus of the present study (i.e., older patients' disease management behaviours as a function of their beliefs about diabetes), we currently examine data provided by patients only. A total of 116 patients provided complete data on all major study variables and were included in the present analyses.

On average, patients had been diagnosed with type 2 diabetes for 11.7 years ($SD = 9.4$). Patients' mean HbA1c at baseline (reported by diabetes care providers for a subset ($N = 68$) of patients) was 7.1% ($SD = 1.1$) (HbA1c reflects the proportion of haemoglobin to which glucose is bound; normal HbA1c for someone without diabetes is $< 6\%$). Patients' mean BMI at baseline (based on self-reported height and weight) was 31.2 ($SD = 7.5$). A majority of patients (78%) required oral medication for their diabetes, and insulin was prescribed for slightly more than one third (35%). The diabetes complications most frequently reported by patients were foot problems (28%), nerve damage or amputation (26%), and vision problems (18%). Many patients also reported co-morbid health conditions; the most common were heart disease (41%), stroke (16%), and asthma (13%). Additional demographic characteristics of these patients are displayed in Table 1. Comparisons of patients who did and did not complete all three waves of the study revealed no significant differences on demographic or disease-related characteristics or major study variables. (approximate position for Table 1)

Main Measures

Dietary Adherence: At T1 and T3, patients reported how often they had followed a healthy diet during the previous week using items from the diet subscale of the Summary of Diabetes Self-Care Activities measure (SDSCA; Toobert, Hampson, & Glasgow, 2000). This measure was a mean of five items (e.g., ate five or more servings of fruits and vegetables) that were rated on a scale from 0 to 7, which indicates on how many days of the prior week patients followed a healthy diet. The SDSCA is a well-validated measure of diabetes adherence that demonstrates acceptable internal consistency and sensitivity to change in adherence behaviours over time; the diet subscale, in particular, correlates well with multiple criterion measures of dietary adherence (Toobert et al., 2000). In the current study, patients' baseline scores on the SDSCA diet subscale correlated significantly ($r = -.31$, $p < .001$) with their mean daily blood glucose levels (recorded by patients ~2–3 times per day using personal glucose monitors as part of a 24-day diary assessment that began after the baseline interview). The observed mean of dietary adherence at T3 was 4.58 ($SD = 1.54$; range = 0–7; $\alpha = .78$).

Illness Beliefs: At T2, patients indicated to what extent they agreed with statements about the nature of their type 2 diabetes using items from the revised Illness Perception Questionnaire (IPQ-R; Moss-Morris et al., 2002). The validity of the IPQ-R has been demonstrated across a variety of health conditions, including type 2 diabetes (Hagger & Orbell, 2003). As suggested by the measure's developers (Moss-Morris et al., 2002), items were modified to refer specifically to type 2 diabetes. For the present study, patients responded to items pertaining to the duration of their diabetes and the variability of their diabetes symptoms. *Disease duration beliefs* were a mean of four items from the “timeline acute/chronic” subscale of the IPQ-R (e.g., You will have diabetes for the rest of your life). Items were rated on a scale from 1 (*strongly disagree*) to 7 (*strongly agree*). Higher scores indicate patients' stronger belief that their diabetes is chronic. The observed mean was 6.29 (SD = 0.96; range = 3–7; $\alpha = .76$).

Symptom variability beliefs were a mean of three items (e.g., Your diabetes symptoms come and go in cycles) from the “timeline cyclical” subscale of the IPQ-R. Items were rated on a scale from 1 (*strongly disagree*) to 7 (*strongly agree*), with higher scores indicating patients' stronger belief that their diabetes symptoms are variable. The observed mean was 3.70 (SD = 1.50; range = 1–7; $\alpha = .73$).

Means, standard deviations, and bivariate correlations of all major study variables are shown in Table 2. (approximate position for Table 2)

Covariates—To assess change in patients' dietary adherence over time, we predicted dietary adherence at T3 while controlling for its baseline (T1) assessment (Finkel, 1995). Additional covariates were selected using a partial correlation procedure. Demographic (e.g., age, race) and disease-related (e.g., length of diabetes diagnosis, diabetes-specific distress) variables that may have a bearing on change in patients' dietary adherence were examined as potential covariates. Variables were included as covariates in our analyses if their associations with patients' T3 adherence were significant at $p < .10$, while controlling for T1 adherence; only T3 diabetes-specific distress and a measure of whether patients' T3 dietary adherence was typical of their usual adherence met this criterion and are described below.

Diabetes-Specific Distress: At T3, patients reported the extent to which they experienced emotional distress as a result of their diabetes using the Problem Areas in Diabetes Scale (PAID; Polonsky et al., 1995). This measure was a mean of 20 items (e.g., feeling guilty or anxious when you get off track with your diabetes management), which were rated on a scale of 0 (*no problem*) to 5 (*serious problem*). Higher scores indicate a higher level of distress related to diabetes. The observed mean was 1.00 (SD = 1.03; range = 0–5; $\alpha = .97$).

Dietary Adherence Typical of Month: At T3, one item assessed whether the week for which patients reported dietary adherence was representative of their usual dietary adherence (i.e., Would you say your dietary choices this past week were typical of your dietary choices over the past month?). For analyses, “yes” responses were coded as 0, and “no” responses were coded as 1. Eighty-five patients (73.3%) reported that their dietary adherence was typical.

Overview of Analyses—The study hypothesis and exploratory gender differences were tested simultaneously to avoid unnecessarily increasing the number of analyses conducted and, thus, the risk of type I error. Accordingly, one hierarchical regression analysis investigated the interactive effects of duration beliefs (T2), variability beliefs (T2), and gender on dietary adherence at T3, controlling for baseline (T1) adherence. T1 dietary adherence and other covariates were entered into the first block; duration beliefs, variability

beliefs, and gender were entered into the second block; and all possible 2-way interactions between duration beliefs, variability beliefs, and gender were entered into the third block. Finally, the three-way interaction of duration beliefs, variability beliefs, and gender was entered into the fourth block. All interaction terms were created with centred variables, and gender was effect coded, such that male patients were coded as -0.5 , and female patients were coded as 0.5 . Significant interaction terms were decomposed according to the technique described by Jaccard and Turrissi (2003). That is, we conceptualized variability beliefs as the moderator and tested the slope of duration beliefs on change in dietary adherence for patients who scored one standard deviation above and below the mean on variability beliefs.

Results

Before testing our hypothesis, we investigated change in dietary adherence from T1 to T3 among the total sample, as well as among male and female patients separately. Change was defined as being greater than one half of a standard deviation, which is consistent with a medium effect size (Cohen, 1988). For the total sample, 24.14% of patients decreased their dietary adherence from T1 to T3, 26.72% improved their adherence, and 49.14% showed no significant change. Among male patients, 14.29% decreased their adherence over time, 32.14% improved, and 53.57% showed no change. Among female patients, 33.33% decreased their adherence over time, 21.67% improved, and 45.00% showed no change. A significantly larger proportion of female patients exhibited declines in their dietary adherence from T1 to T3, compared to male patients ($\chi^2(114) = 2.18, p = .02$), but there were no significant differences in the proportions of male and female patients who showed either improvement or no change in adherence from T1 to T3.

We also conducted independent-samples t-tests to investigate gender differences in mean levels of patients' timeline beliefs and dietary adherence. There were no significant differences in male and female patients' duration beliefs ($t(114) = 0.43, p = .67$) or variability beliefs ($t(114) = -0.86, p = .39$). Likewise, no gender differences in patients' T1 ($t(114) = -0.96, p = .34$) or T3 dietary adherence ($t(114) = 0.99, p = .32$) were observed.

Interaction of Duration Beliefs and Variability Beliefs

Results for regression analyses predicting change in older adults' dietary adherence from T1 to T3 from their duration beliefs and variability beliefs assessed at T2 (Aim 1) are shown in Table 3. As hypothesized, the interaction term for duration beliefs and variability beliefs significantly predicted change in dietary adherence over time ($\beta = -.17, p = .03$).

(approximate position for Table 3) Consistent with expectations, among patients who believed their diabetes symptoms to be less variable (i.e., more stable), duration beliefs were positively associated with improvement in dietary adherence at T3 ($\beta = .25, p = .01$); in contrast, among patients who believed their symptoms to be more variable (i.e., less stable), there was no significant association between duration beliefs and change in adherence ($\beta = -.11, p = .38$).

Gender Differences

The three-way interaction of duration beliefs, variability beliefs, and gender (Aim 2) was also a significant predictor of change in older adults' dietary adherence ($\beta = .21, p = .01$), indicating that the interaction of duration beliefs and variability beliefs differed for men and women. As shown in Figure 1, the significant interaction term observed for the sample as a whole remained significant for male patients ($\beta = -.32, p = .002$), but not for female patients ($\beta = .10, p = .38$). Thus, for older men who believed their diabetes symptoms to be less variable (i.e., more stable), the more strongly they believed that type 2 diabetes was of long

duration, the more improvement they showed in their diet ($\beta = .33, p = .01$); whereas, among men who believed their symptoms to be more variable (i.e., less stable), duration beliefs were not significantly related to change in dietary adherence over time ($\beta = -.30, p = .08$). In contrast, among older women, duration beliefs were unrelated to change in dietary adherence regardless of the strength of their variability beliefs. (approximate position for Figure 1)

Discussion

The assumed interaction of individuals' abstract and concrete representations of illness is one key component of the CSM that has received little empirical scrutiny. The current study investigated this theoretical assumption by examining the interaction of older adults' beliefs about the duration and variability of their type 2 diabetes (i.e., timeline beliefs) as a predictor of change in dietary adherence over one year. In support of CSM theory, our findings indicated that older patients' variability beliefs conditioned the association between their beliefs about disease duration and the extent to which their adherence to a prescribed diet changed over time. In exploratory analyses of gender differences, however, the interaction between duration beliefs and variability beliefs was observed for male but not for female patients.

Male Patients' Timeline Beliefs and Adherence

Among the older men in our study, the interplay of abstract and concrete beliefs about the timeline of type 2 diabetes significantly predicted improvement in adherence to a healthy diet over the course of one year. Consistent with our general hypotheses, beliefs about the duration of diabetes were positively related to improvement in dietary adherence from T1 to T3 among male patients who believed that their diabetes symptoms are stable and consistent. In contrast, among male patients who viewed the symptoms of their diabetes as variable and fluctuating, duration beliefs had no adherence-promoting effects. Findings for male patients are in line with both CSM theory and previous empirical work on timeline-related illness beliefs in mixed-gender samples.

Across a variety of diseases (e.g., hypertension, diabetes), stronger belief in a chronic timeline has been associated with better adherence to multiple aspects of treatment and disease management (e.g., Meyer et al., 1985; Searle et al., 2007), perhaps because it conveys a sense of severity. When patients view a disease as chronic, they are more likely to believe that it has serious consequences, which could promote disease management efforts (Benyamini, Medalion, & Garfinkel, 2007; Paschalides et al., 2004). Conversely, perceiving disease symptoms as highly variable appears to discourage proper disease management (e.g., Barnes et al., 2004). Patients who perceive that disease symptoms fluctuate or recur may come to believe that treatment is required only when symptoms are present, even when a disease actually requires constant care (H. Leventhal et al., 2003). The perception that symptoms come and go could also decrease patients' sense that they have the ability to control the disease and thereby discourage adherence behaviours (Moss-Morris et al., 2002).

The finding that older male patients' duration beliefs were associated with improved dietary adherence only when variability beliefs were weak suggests that when abstract and concrete timeline representations have conflicting implications for disease management behaviours, the effects of the former can be overridden by those of the latter. This interpretation is in line with Leventhal's discussion of bottom-up influence, whereby somatic sensations can alter the effects of abstract beliefs about a disease (H. Leventhal et al., 2003).

Somewhat similar findings were observed in a study of beliefs about the timeline of asthma among a mixed-gender sample. Individuals who viewed their asthma as a series of acute

episodes with “disease free” periods in between (i.e., *no symptoms, no asthma* belief) were also less likely to think that medication was necessary during symptom-free periods. Importantly, these individuals were less adherent to asthma medications when they were asymptomatic, compared to those who held a chronic view of their asthma (Halm et al., 2006). In a similar vein, patients who believed that they only have type 2 diabetes when their blood sugar is high were more likely to be nonadherent with medication regimens (Mann et al., 2009). The current study builds on these findings by suggesting that even when patients (specifically male patients) know that their disease has a chronic timeline, they may still base their performance of disease management behaviours on their experience of symptoms. In other words, despite knowledge of a disease’s long-term nature, men may fail to adhere consistently to treatment regimens when experiencing phases of relatively mild or infrequent symptoms.

Such a scenario could be common among older men with type 2 diabetes. Most patients are aware that diabetes is a chronic disease, but endorse a wider range of beliefs about the variability of symptoms (Barnes et al., 2004; Searle et al., 2007; Sultan, Attali, Gilberg, Zenasni, & Hartemann, 2011). Diabetes symptoms vary from person to person, and even within the same person at different times. Many factors (e.g., glucose management, stress, minor illnesses) could contribute to symptoms being sometimes better and sometimes worse. Experiencing symptoms as fluctuating may be at odds with the knowledge that a disease is chronic (and therefore, always present). Thus, older men who experience or perceive their diabetes symptoms as highly variable may be less likely to behave as though their condition is chronic, which could ultimately have serious implications for their long-term health.

Female Patients’ Timeline Beliefs and Adherence—In contrast to male patients, among the female patients in our study the interaction of beliefs about disease duration and beliefs about symptom variability did not contribute significantly to improvement in dietary adherence over the course of a year. CSM theory does not address potential gender differences in the illness representations process, but we may speculate as to why female patients failed to respond to abstract and concrete timeline beliefs in the expected manner. Given that the proportion of all patients in our study who exhibited major change in their dietary adherence (i.e., better or worse) did not differ by gender (analyses not shown), the null findings observed among women could not be a result of their having less change to predict. Multiple influences contribute to the adherence behaviours of patients with diabetes (e.g., Gonder-Frederick et al., 2002), and it may be that female patients are more strongly influenced by factors other than timeline-related illness beliefs. In one study of older adults with type 2 diabetes, beliefs about personal responsibility for causing the disease were more predictive of female patients’ dietary intake than that of male patients (Hampson et al., 1995). In addition, women are traditionally more concerned about food choices and nutrition than are men (e.g., Wardle et al., 2004), and these concerns may be more relevant to their dietary adherence than are beliefs about the timeline of disease. Accordingly, it is important to note that the gender differences observed in our study may be specific to dietary behaviours and that a different pattern of gender-related findings may emerge when examining other health behaviours, such as physical activity or medication adherence.

Although gender is not a key component of the CSM, the complex gender interactions observed in our study and elsewhere (e.g., Hampson et al., 1995) suggest that gender differences in CSM processes may be a fruitful area of future research. Interaction effects are often difficult to detect in field research (McClelland & Judd, 1993), and as such, the observation of a significant three-way interaction in the current study speaks to the potential strength of this relationship. Given the exploratory nature of our gender analyses, however, replication of the three-way interaction of patients’ gender, duration beliefs, and variability beliefs is needed.

Limitations

Our longitudinal study of older adults' abstract and concrete timeline beliefs and diabetes management should be considered in light of its limitations. Due to our study's correlational design, we are unable to entirely rule out the possibility of reverse causation. Through statistical analysis, we tried to ensure that our results reflected the influence of illness beliefs on disease management. By adjusting for T1 adherence, we accounted for the effects of initial differences among patients in dietary adherence on the relationship between timeline beliefs and adherence one year later. Of course, as posited by the CSM, illness beliefs and disease management behaviours are likely to have reciprocal effects on one another (H. Leventhal et al., 2003). Additionally, although timeline beliefs have been found to be quite stable over a one-year period among adults with type 2 diabetes (French et al., 2008; Skinner et al., 2011), our single assessment of patients' timeline beliefs did not allow us to examine possible change in these beliefs from T2 to T3 or the implications of such change for patients' dietary adherence over time.

The high average score for disease duration beliefs suggests that most study participants held accurate views about the chronic nature of type 2 diabetes, yet it also suggests that a ceiling effect for this variable may have limited our ability to detect smaller associations. Nonetheless, that we were able to detect predicted effects of duration beliefs indicates that even small variations in this particular illness belief have implications for disease management.

Additionally, our measures relied on patients' self-reports, which may be susceptible to social desirability and recall bias (Dunbar-Jacob & Schlenk, 2001). Although we were able to validate patients' self-reported dietary adherence with their average blood glucose reading, future studies may want to employ more objective measures of dietary adherence (e.g., daily food records, weighing/measuring of portions, digital photography of meals).

Finally, rates of type 2 diabetes are higher among minority populations than among Caucasians (CDC, 2011b), and metabolic control and disease management behaviours tend to be poorer among African Americans and Hispanics with diabetes, compared to Caucasians (e.g., Oster et al., 2006). It is possible that differences in beliefs about diabetes contribute to ethnic and racial disparities in diabetes management (Thackeray, Merrill, & Neiger, 2004). Given that minority individuals (predominately African Americans) comprised less than a quarter of our sample, we were unable to examine this possibility in the current study. Future work should evaluate the implications of abstract and concrete timeline beliefs for disease management in more diverse samples that reflect national trends in the prevalence of type 2 diabetes.

Conclusions

Despite these limitations, the current study is an important contribution to the large theoretical and empirical literature that has been generated by the common-sense model of self-regulation. Our study provides some of the first support for an under investigated tenet of Leventhal's theory – that abstract and concrete levels of one's mental representations of illness interact with each other to guide self-management of health threats. More specifically, our findings indicate a bottom-up process of influence, whereby individuals' concrete experiences of disease symptoms alter the behavioural effects of their abstract disease-related knowledge. In addition to this theoretical contribution, our findings have implications for clinical practice: efforts to educate and improve the self-management of older adults with type 2 diabetes (perhaps specifically interventions with older men) should emphasize the necessity of long-term, constant management, even during times that are relatively symptom-free.

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Figure 1.
Interaction of disease duration beliefs and symptom variability beliefs predicting change in dietary adherence for male and female patients separately.

Table 1

Demographic characteristics of total sample and male and female patients separately.

Variable	Total Sample (N = 116)			Male Patients (N = 56)			Female Patients (N = 60)		
	M (SD)	Range		M (SD)	Range		M (SD)	Range	
Age	65.99 (7.78)	55–85		67.14 (7.39)	55–85		64.92 (8.04)	55–83	
Years of Education	13.84 (2.42)	8–17		13.93 (2.54)	8–17		13.77 (2.32)	9–17	
Years Diagnosed	11.68 (9.41)	1–40		13.18 (9.58)	1–36		10.25 (9.10)	1–40	
Race/Ethnicity									
% Caucasian	77.6			78.6			76.7		
% African American	20.7			19.6			21.7		
Median Household Income	\$40,000–59,999			\$40,000–59,999			\$40,000–59,999		

Table 2

Means, standard deviations (SD), and bivariate correlation coefficients of major study variables (N = 116).

Variable	1	2	3	4	Mean	SD
1. T1 Dietary Adherence	---				4.44	1.66
2. T3 Dietary Adherence	.57***	---			4.58	1.54
3. Disease Duration Beliefs	.16	.18*	---		6.29	0.96
4. Symptom Variability Beliefs	-.23**	-.13	-.02	---	3.70	1.50
5. Gender	.09	-.09	-.04	.08	---	---

* $p < .05$.

** $p < .01$.

*** $p < .001$.

Table 3

Hierarchical regression analysis predicting change in patients' dietary adherence from disease duration beliefs, symptom variability beliefs, and gender (N = 116).

Variable	Patients' T3 Dietary Adherence			
	B (SE)	β	ΔR^2	f^2
Duration Beliefs	.18 (.11)	.12		
Variability Beliefs	.09 (.08)	.09		
Gender	-.15 (.23)	-.05	.02	.04
Duration Beliefs * Variability Beliefs	-.19 (.09)	-.17 *		
Duration Beliefs * Gender	-.01 (.23)	-.002		
Variability Beliefs * Gender	-.17 (.15)	-.08	.03 †	.06
Duration Beliefs * Variability Beliefs * Gender	.48 (.19)	.21 **	.03 **	.06

Note: f^2 denotes effect size based on the amount of variance uniquely explained by each set of predictor variables in the hierarchical regression analysis. Model controls for T1 dietary adherence ($\beta = .58^{***}$), T3 dietary adherence typical of month ($\beta = -.24^{***}$), and T3 diabetes-specific distress ($\beta = -.23^{**}$); R^2 for covariates = .43; f^2 for covariates = .75.

† $p < .10$.

* $p < .05$.

** $p < .01$.

*** $p < .001$.