Research Article

Clinical and Socio-demographic Determinants of Self-care Maintenance, Monitoring and Management in US Adults with Type 2 Diabetes Mellitus

Clinical Nursing Research
1–8

DOI: 10.1177/1054773820916987
journals.sagepub.com/home/cnr
SAGE

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Abstract

The aims of this study were to describe self-care in US T2DM patients and to identify clinical and sociodemographic determinants of self-care maintenance, monitoring, and management in US T2DM patients. A secondary analysis was performed using data from a cross-sectional study done to test the psychometric performance of the Self-Care of Diabetes Inventory in US English speaking adults with diabetes. In our sample ($n = 207$), self-care maintenance was adequately performed (median = 75), self-care monitoring was borderline (median = 67.6) and self-care management was poor (median = 55.6). Low income ($p = .0019$) and low self-care confidence ($p < .0001$) were associated with relatively lower self-care maintenance. Not taking insulin ($p = .0153$) and low self-care confidence ($p < .0001$) were associated with relatively low self-care monitoring. Low self-care confidence ($p < .0001$) was associated with low self-care management. Self-care confidence is a strong determinant of self-care. Interventions designed to improve self-care confidence are urgently needed.

Keywords

type 2 diabetes mellitus, self-care, self-management, self-efficacy

Introduction

Diabetes is considered one of the health emergencies of the 21st century, affecting 425 million people worldwide (International Diabetes Federation, 2017). In the United States (US) its prevalence is around 13%, with about 30 million people currently living with diabetes (International Diabetes Federation, 2017). Type 2 diabetes mellitus (T2DM), accounting for 90% of these cases (International Diabetes Federation, 2017), is associated with macro and microvascular complications such as cardiovascular disease, nephropathy, neuropathy, retinopathy, stroke and cerebrovascular disease (Alberti & Zimmet, 1998; Hardigan et al., 2016; International Diabetes Federation, 2017). These complications can be seriously debilitating, lowering quality of life (International Diabetes Federation, 2017; Scollan-Koliopoulos et al., 2013) and imposing a huge personal burden (Bommer et al., 2017; International Diabetes Federation, 2017). The economic burdens to individuals and society are also staggering; in the US, each person with diabetes expends around 11,638 USD per year, for a total annual expenditure of 348,274 million USD (International Diabetes Federation, 2017).

Self-care is a key component for managing diabetes (Powers et al., 2017; Song, 2010). Self-care is defined as the process of maintaining health through health promoting practices and managing illness (Riegel et al., 2012, p. 195, 2018). Self-care in T2DM has been shown to reduce hemoglobin

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A1c (Powers et al., 2017; Song, 2010), complications (Ausili et al., 2017b), hospitalization (Powers et al., 2017; Song, 2010; Song et al., 2012) and, consequently, costs, while improving quality of life (Ausili et al., 2017b; Powers et al., 2017; Song, 2010) and psychosocial outcomes (Powers et al., 2017). Theoretically, self-care is composed of three core processes: self-care maintenance, self-care monitoring and self-care management (Riegel et al., 2012, p. 195, 2018). Self-care maintenance focuses on maintaining health and preventing the worsening of symptoms (e.g., adherence to medications, nutrition, exercise, etc.), self-care monitoring involves body listening and other processes designed to detect and interpret changes, and self-care management is done to effectively treat those changes in signs and symptoms (Riegel et al., 2012, p. 195, 2018). A fourth factor known to influence self-care is self-care confidence (Ausili et al., 2018; Caruso et al., 2019). Self-care confidence is the confidence in one's ability to perform self-care and persist in self-care despite barriers (Riegel et al., 2012).

Knowing determinants of self-care in the T2DM population can help identify people at risk for poor self-care and direct the development of tailored interventions. Previous studies investigating determinants of self-care in T2DM focused on a single behavior (Bonner et al., 2016; Karimy et al., 2016; Koponen et al., 2017) or were performed without an organizing theoretical framework (Clark & Utz, 2014; Walker et al., 2014). The only study of determinants of self-care in T2DM with a comprehensive approach guided by a theoretical framework was done in an Italian population (Ausili et al., 2018). In that study, age was associated with self-care maintenance, time from diagnosis with self-care monitoring, employment status with self-care maintenance and self-care management, and economic status with self-care maintenance and self-care management (Ausili et al., 2018). Age and self-care confidence were associated with self-care maintenance, self-care monitoring and self-care management (Ausili et al., 2018).

As that study (Ausili et al., 2018) was performed in Italy and determinants of self-care are intrinsically linked with socio-cultural conditions and health systems organization and resources (Osokpo & Riegel, 2019), it is important to study determinants in other contexts. To address these gaps, the aims of this study were to: 1) describe self-care maintenance, monitoring, management and confidence in a US sample of adults with T2DM; and 2) identify clinical and sociodemographic determinants of self-care maintenance, monitoring, and management in US patients with T2DM.

Methods

We conducted a cross-sectional study with the aim of testing the psychometric performance of the Self-Care of Diabetes Inventory (SCODI) (Ausili et al., 2017a) in US English speaking patients with diabetes (Ausili et al., 2019). This study was a secondary analysis of data coming from that primary cross-sectional study. Participants were enrolled from two acute care hospitals in northeastern US and ResearchMatch.org. The Institutional Review Board of the University of Pennsylvania approved the study after expedited review. Informed consent was provided by each participant.

Sample

Hospitalized individuals with a diagnosis of diabetes were eligible to participate if they were at least 18 years of age. Exclusion criteria were cognitive impairment and an inability to participate due to poor hearing, inability to read or speak English. In addition, 79 volunteers from ResearchMatch.org responded to our online invitation to complete the SCODI and the sociodemographic survey if they had diabetes. ResearchMatch.org is an electronic, web-based registry of a large population of volunteers who have consented to be contacted by researchers about health studies. The registry is supported by the U.S. National Institutes of Health as part of the Clinical Translational Science Award program. After obtaining Institutional Review Board approval of the study, we posted an invitation on ResearchMatch.org and obtained data from anyone willing to provide it.

Measurement

Self-care maintenance, monitoring, management and confidence were measured by the SCODI (Ausili et al., 2017a) and were defined above. Self-care maintenance is thought to be mastered before self-care monitoring and management. That is, the three self-care behavior types are thought to be mastered in sequence (Riegel et al., 2012). Self-care confidence, also called self-care self-efficacy, is one's confidence in the ability to perform self-care and continue self-care despite barriers (Riegel et al., 2012). It has been shown to be a strong determinant of self-care in previous studies in diabetes (Ausili et al., 2018; Caruso et al., 2019).

Each of the four scales of the SCODI provides a standardized 0–100 score. Higher scores indicate better self-care and a score of $\geq$70 is considered adequate self-care (Ausili et al., 2017a). Each of the four scales of the SCODI showed good to excellent psychometric properties. For example, the reliability index ranged from 0.81 (self-care maintenance) to 0.89 (self-care confidence) (Ausili et al., 2017a). The SCODI's validity was also demonstrated by the significant associations with HbA1c, BMI, and complications (Ausili et al., 2017a). Furthermore, the instrument was recently tested for invariance between the Italian and USA population, demonstrating a cross-country measure equivalence (Ausili et al., 2019). In addition, we administered a sociodemographic survey measuring age, sex, ethnicity, marital status, adequacy of family income, employment, and education. We asked how long the participant had diabetes and about their comorbid conditions, medications (insulin or oral blood

glucose lowering medications only) and the presence of diabetes complications (diabetic retinopathy, diabetic foot, diabetic neuropathy, and diabetic kidney disease).

Data Analysis

Demographic and clinical characteristics were described by means or median and interquartile range (IQR), for continuous variables, and frequency and percentage, for qualitative variables, accounting only for present data. Score distributions were represented by means of boxplot, median and IQR.

Given the non-normal distribution of the self-care scales, to evaluate which were the determinants of each score, quantile regression was adopted to regress the median of scales scores on the collected patient information. Thus, the parameter estimated by the model is interpreted as an increment of the median (instead of the usual mean), for each unit increment in the independent factors. The regression parameters were estimated by the algorithm Simplex because of the small number of subjects and independent variables included in the models. Confidence intervals and p-values were estimated using the Sparsity function and assuming that the errors in the linear model are independent and identically distributed. P-values were considered statistical significant if lower than 0.05.

Results

Of the 207 T2DM patients enrolled, 43.7% were females. The median age was 61 years old (interquartile range: 55.0–68.0). Most were married or partnered (57.4%) and fewer than 30% were educated at the college level or higher. The majority of participants were White/Caucasian (66.7%), followed by Black/African American (28%), and Asian (2.4%).

More than 60% was unemployed or retired and 17% reported a low family income that was perceived as inadequate to meet needs. The median time from the diagnosis of T2DM was 13 years (interquartile range: 6.0–20.0), 50% had at least one diabetes-related microvascular complication, and 75% had 3 or more comorbidities. The most prevalent comorbidities were hypertension (75.6%) and heart failure (67.4%). Sociodemographic and clinical characteristics of the study sample are shown in Table 1.

Self-care maintenance was performed adequately by the study participants (median = 75; interquartile range: 66.7–85.4). Self-care monitoring was borderline in adequacy (median = 67.6; interquartile range: 50.0–85.3) and self-care management was poor (median = 55.6; interquartile range: 41.7–72.2). Patients reported high confidence in their ability to perform adequate self-care behaviors as shown by their self-care confidence scores (median = 81.8; interquartile range: 65.9–93.2). Box-plots representing the self-care maintenance, monitoring, management and confidence distributions are reported in Figure 1.

Together, having a low income ($p = .0019$) and low self-care confidence ($p < .0001$) were associated with relatively lower self-care maintenance (Table 2). Not taking insulin ($p = .0153$) and having low self-care confidence ($p < .0001$) were associated with relatively lower self-care monitoring (Table 3). Having low self-care confidence ($p < .0001$) was associated with low self-care management (Table 4).

Discussion

The purpose of this study was to describe self-care maintenance, monitoring, and management and to identify the clinical and sociodemographic factors associated with the core self-care dimensions of maintenance, monitoring and management in US T2DM patients. The profile of patients was not appreciably different from other chronically ill patient populations: older adults with multiple chronic conditions. Their self-care profile also was typical in that they were best at self-care maintenance and worst at self-care management. Additionally, we found no effects of gender or education on diabetes self-care management, which is consistent with previous results (Rosland et al., 2010).

The most striking result in this analysis was the powerful effect of self-care confidence on self-care behavior. Confidence or self-efficacy was a determinant of self-care maintenance, monitoring, and management. These results are similar to other studies on diabetes (Ausili et al., 2017a) and heart failure (Irani et al., 2019) self-care, suggesting that interventions designed to improve self-care self-efficacy have a strong potential for improving self-care. For example, a recent randomized controlled trial utilizing self-efficacy theory targeted and improved both self-efficacy and hemoglobin A1c (Wichit et al., 2017). Furthermore, a recent systematic review and meta-analysis of self-efficacy interventions found evidence for the effects of self-efficacy on self-management behaviors and glycemic control (Jiang et al., 2019).

Bandura separated self-efficacy into self-efficacy expectations and outcome expectations (Bandura, 1977). Efficacy expectations are defined as "the conviction that one can successfully execute the behavior required to produce the outcomes" (Bandura, 1977). Of the two, self-efficacy expectation is thought to be the main predictor of behavior (Bandura, 1977). Research on self-efficacy has found significant positive correlations with health outcomes such as reduced depression, increased physical functioning, improved health promotion (Eller et al., 2018). Higher levels of diabetes self-efficacy are associated with and predict better diabetes self-management (Jiang et al., 2019; McEwen et al., 2017) and glycemic control (Elissen et al., 2017).

Not all research supports the mediating effects of self-efficacy, however. Studies on self-efficacy interventions to increase physical activity in older adults showed improvements in physical activity without increases in self-efficacy expectations (Resnick, 2013). These results need further clarification as they may have been due to measurement

Table 1. Sociodemographic and Clinical Characteristics of the Sample ($n = 207$).

Characteristics	Type 2 N (%)
Age (median, IQR)	61.0 (55.0–68.0)
Gender ($n = 206$)	
Male	116 (56.3)
Female	90 (43.7)
Ethnicity	
Asian	5 (2.4)
Black/African American	58 (28.0)
White/Caucasian	138 (66.7)
Other (e.g., Native American)	6 (2.9)
Marital Status ($n = 204$)	
Divorced, separated, or widowed	47 (23.0)
Married or partnered	117 (57.4)
Single, never married	40 (19.6)
Education ($n = 206$)	
High School Graduate or below	54 (26.2)
Some College (Associate's, Vocational, etc)	71 (34.5)
College Educated	41 (19.9)
Master's Degree and above	40 (19.4)
Employment Status ($n = 173$)	
Full or part time	57 (32.9)
Unemployed or Retired	116 (67.1)
Income ($n = 205$)	
Comfortable; have more than enough to make ends meet	77 (37.6)
Have enough to make ends meet	93 (45.4)
Do not have enough to make ends meet	35 (17.1)
Diabetes	
Years with diabetes (median, IQR) ($n = 203$)	13.0 (6.0–20.0)
Total Complications (median, IQR) ($n = 135$)	1.0 (0.0–2.0)
Diabetic Foot	32 (23.7)
Neuropathy	61 (45.2)
Retinopathy	33 (24.4)
Nephropathy	39 (28.9)
Clinical Characteristics	
Total Diseases (median, IQR) ($n = 135$)	5.0 (3.0–6.0)
Hypertension	102 (75.6)
Heart Failure	91 (67.4)
Arthritis	63 (46.7)
Kidney Disease	57 (42.2)
Pulmonary Disease (asthma, emphysema, lung disease)	29 (21.5)

errors, instrument design, and ceiling effects (Resnick, 2013). In contrast, a diabetes self-efficacy intervention improved self-care, self-efficacy and glycemic control (Tan et al., 2018). Comparing results across studies is challenging, however, as studies utilize multiple methods for evaluating self-care and self-efficacy. Considering that studies utilizing the SCODI have obtained similar results (Ausili et al., 2017a, 2018; Caruso et al., 2019), the current results are reassuring and lend further support for the importance of self-care efficacy.

The results of this study have implications for future self-care interventions targeting self-efficacy. Effective interventions such as family-based diabetes self-care have been largely successful in improving self-efficacy (Baig et al., 2015). Moreover, improvements in behavior through enhanced self-efficacy may generalize to behaviors that were

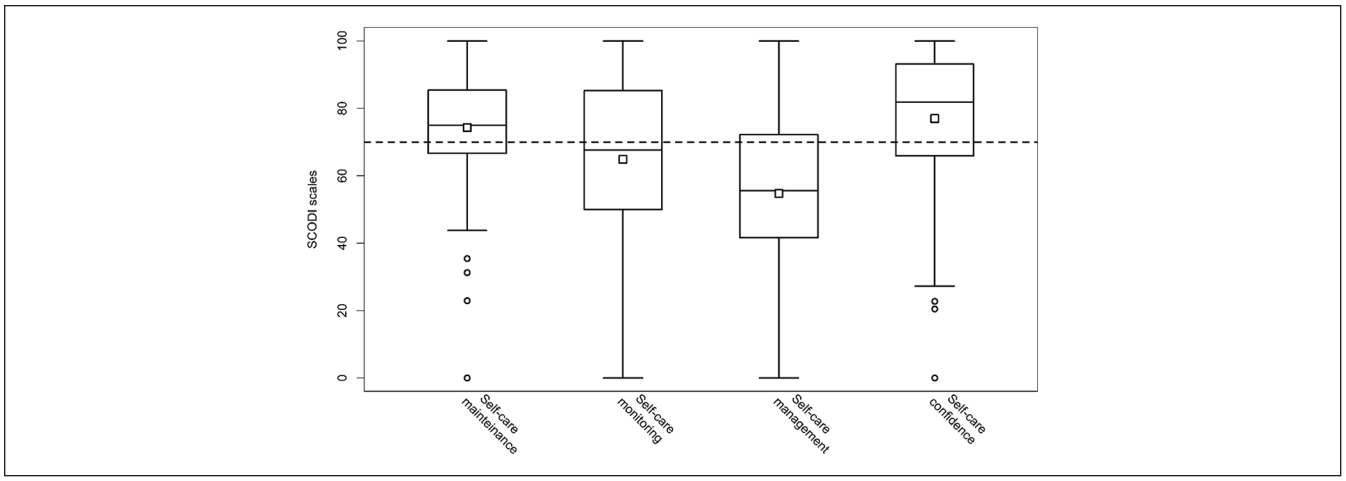

Figure 1. Box-plots representing self-care maintenance, monitoring, management and confidence distributions.
Note. The box represents the first and third quartiles, the central line the median, the white square the mean, and the whiskers are located at the maximum and minimum observation if these are in the range of 1.5 × interquartile range from the box. Outside observation is indicated with dots. Dashed line represents the cut-off level of 70 points.

Table 2. Clinical and Sociodemographic Determinants of Self-care Maintenance.

Variable	Direction	Estimate	Standard Error	95% Confidence Limits		Pr > |t|
Gender	Female versus Male	2.2377	2.0127	–1.7340	6.2093	0.2677
Age	Age <60 versus Age ≥60	–0.2315	2.1747	–4.5227	4.0598	0.9153
Ethnicity	White/Caucasian versus Others	0.0772	2.1124	–4.0913	4.2456	0.9709
Income	Low versus Adequate or High	–8.4105	2.6640	–13.6675	–3.1535	0.0019
Years from the diagnosis	<10 years versus ≥ 10 years	0.0000	2.1672	–4.2766	4.2766	1.0000
Education	High school or lower versus College or Higher	–2.0062	2.3366	–6.6170	2.6047	0.3917
Medications	No insulin versus Insulin	–0.2315	2.6314	–5.4240	4.9611	0.9300
Self-care confidence		0.4414	0.0474	0.3478	0.5350	<.0001

Table 3. Clinical and Sociodemographic Determinants of Self-care Monitoring.

Variable	Direction	Estimate	Standard Error	95% Confidence Limits		Pr > |t|
Gender	Female versus Male	0.8216	3.1102	–5.3151	6.9584	0.7919
Age	Age <60 versus Age ≥60	–4.6797	3.3354	–11.2607	1.9013	0.1623
Ethnicity	White/Caucasian versus Others	1.0360	3.2908	–5.4572	7.5291	0.7533
Income	Low versus Adequate/High	2.5006	4.0934	–5.5760	10.5772	0.5420
Years from the diagnosis	<10 years versus ≥ 10 years	–4.4773	3.3088	–11.0059	2.0514	0.1777
Education	High school or lower versus College or Higher	1.2979	3.6022	–5.8095	8.4053	0.7190
Medications	No insulin versus Insulin	–10.1810	4.1589	–18.3869	–1.9751	0.0153
Self-care confidence		0.7702	0.0731	0.6259	0.9145	<.0001

not initially targeted (Bandura, 1977). Future interventions may focus on providing autonomy support as a means of improving self-efficacy (Lee et al., 2019). Successful performance of a behavior is positively correlated with improved self-efficacy (Glanz et al., 2014). A recent qualitative study of 14 heart transplant patients one-year post-transplant, reinforced the large impact performance accomplishment has on self-efficacy expectations (Almgren et al., 2017). Other potential mechanisms that influence self-efficacy expectations include verbal persuasion or encouragement, role

Table 4. Clinical and Sociodemographic Determinants of Self-care Management.

Variable	Direction	Estimate	Standard Error	95% Confidence Limits		Pr > |t|
Gender	Female versus Male	0.9009	2.8115	–4.6465	6.4483	0.7490
Age	Age <60 versus Age ≥60	–1.9801	3.0354	–7.9691	4.0089	0.5150
Ethnicity	White/Caucasian versus Others	–1.7361	3.0051	–7.6655	4.1933	0.5642
Income	Low versus Adequate/High	6.2312	3.7167	–1.1021	13.5645	0.0953
Years from the diagnosis	<10 years versus ≥ 10 years	–1.5953	3.0045	–7.5235	4.3328	0.5961
Education	High school or lower versus College or Higher	3.1156	3.2700	–3.3364	9.5676	0.3420
Medications	No insulin versus Insulin	–1.5484	3.7227	–8.8936	5.7967	0.6779
Self-care confidence		0.6772	0.0662	0.5466	0.8077	<.0001

modeling, and improved physiological feedback (Bandura, 1977; Glanz et al., 2014).

Limitations

This secondary data analysis was limited by the available original study variables and may not have measured other clinical and sociodemographic factors potentially associated with diabetes self-care. For example, higher levels of diabetes distress and high family barriers to self-management have been associated with decreased self-efficacy (Rosland et al., 2010; Wardian & Sun, 2014). In contrast, diabetes self-care behaviors such as exercise and healthy diet are related to higher self-efficacy (Wardian & Sun, 2014). Also, the sample was composed of participants recruited in different settings, some hospitalized for acute care and some in a community setting. While the study was conducted in the US, our sample characteristics are similar to those reported internationally for chronically ill patients, supporting generalizability of our results. Finally, we used a psychometrically sound tool to measure self-care maintenance, monitoring, management and confidence in the target population (Ausili et al., 2017a, 2019).

Conclusion

For people with T2DM, self-care is key for the management of their illness and the improvement of their outcomes. Self-care is influenced by clinical and socio-demographic determinants and knowing these can help clinicians identify people at risk of performing low levels of self-care. Our findings show self-efficacy as a powerful determinant of self-care maintenance, self-care monitoring, and self-care management. This is relevant because the role of self-efficacy in T2DM remains unclear (Resnick, 2013), although an increasing number of studies tend to assign a key mediating role to it (Ausili et al., 2018; Caruso et al., 2019; Elissen et al., 2017; Jiang et al., 2019; McEwen et al., 2017; Tan et al., 2018). Therefore, future studies will need to better explore this relation. Furthermore, as self-efficacy is a modifiable determinant, future research should test interventions aimed at improving self-care through the enhancement of self-efficacy.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

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