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RESEARCH ARTICLE

Organizing framework to investigate associations between diabetes knowledge, health literacy, and self-care behaviors in patients with type 2 diabetes based on the extended parallel process model

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Abstract

Objective The mechanisms underlying the relations between diabetes self-care behaviors, cognition, and social factors are still equivocal, and it is unclear how diabetes knowledge and health literacy is associated with self-care behaviors. Here, we tested a hypothetical path model linking diabetes self-care behaviors to knowledge, health literacy, and constructs of the extended parallel process model (EPPM) to understand potential predictors that may influence patients' self-care behavior with type 2 diabetes.

Methods A cross-sectional study was conducted, and 404 patients with type 2 diabetes were recruited from healthcare centers in Khaf, Iran. Diabetes self-care behaviors were indicated by, glucose self-control, foot care, physical activity, medications, smoking, and a healthy diet. The main data collection instruments in this study were the Health Literacy for Iranian Adults questionnaire (HELIA), diabetes knowledge, and self-care behavior based on the EPPM questionnaires.

Results The results from path modeling indicated that perceived susceptibility, efficacy, self-efficacy, knowledge, and health literacy were significant ($p < 0.05$) predictors for diabetes self-care behaviors and path model accounted for 32% of the total variance.

Conclusion Based on the results, key constructs of EPPM, diabetes knowledge, and health-related literacy are empirically supported diabetes self-care behaviors. These factors could apply to health professionals for developing educational intervention programs to facilitate a physically active lifestyle.

Keywords Knowledge · Health literacy · Self-care · Path analysis · EPPM

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Abbreviations

HL	Health literacy
EPPM	The extended parallel process model
HELIA	Health Literacy for Iranian Adults questionnaire
CVI	Content Validity Index
CVR	Content Validity Ratio

Introduction

Type 2 diabetes affects close to 415 million people globally [1]. Although, type 2 diabetes accounts for one in six deaths in the world, and is a leading cause of serious macro- and micro-vascular complications in adults (e.g. renal failure, blindness, cardiovascular disease, retinopathy, and lower limb amputation) [1, 2]. Studies have shown that most populations, particularly those living in middle- and low-income countries, have insufficient diabetes knowledge and health literacy (HL) skills related to self-care behaviors and medication adherence [3–5]. It may be possible to reduce the prevalence of diabetes complications and their burden through self-care behaviors in these regions. Inadequate self-care behaviors among patients with type 2 diabetes are acknowledged to be a major risk factor for the development of diabetes complications. Adequate self-care behaviors can positively affect health outcomes among patients with type 2 diabetes and involve controlling the treatment, lifestyle changes, physical and psychosocial consequences inherent [1, 4]. Diabetes self-care behaviors include several tasks, such as dietary management, physical activity, glucose self-control, foot care, and medication utilization [1, 2].

To improve the potential determinants of self-care behaviors, a variety of health promotion theories have been implemented to promote self-care behaviors and lifestyle characteristics [6–8]. EPPM is a theoretical approach to health behavior change [9–11]. Theoretically, this model includes four key constructs that systematically describe the efficacy of health messages when people are motivated to action and/or change behavior: because their beliefs about the magnitude and significance of the threat (perceived severity); and beliefs about the risk of experiencing the threat (perceived susceptibility); that there is an action they can readily take to reduce or control those unpleasant scenarios or threat (self-efficacy); and the treatment is effective for their health (response efficacy) [10, 12]. Even though there is evidence that these four cognitive elements have proved effective in promoting self-care behaviors and health action in different health issues, including teen pregnancy, skin, and breast cancer [9, 10, 13], it is the first time that it has been used to predict people with diabetes' perceptions of threat and efficacy to follow appropriate self-care behaviors.

Furthermore, knowledge and HL are also reported as possible determinants that strongly affect the performance of self-care behaviors among people with chronic diseases [5, 14, 15]. HL refers to the skill to understand health-related information and for generating diabetes knowledge regarding health issues and also to the ability to know where to look for this information, which is up for discussion whether it is a responsibility of the person with chronic disease or the health care system [9, 10, 16–18]. According to the interrelations among the performance of self-care behaviors, HL skills, and knowledge, little research has been undertaken. In this framework, psychological and socio-cognitive (perception, knowledge) factors are proposed as mediators in the relationship between health actions (disease management and self-care behaviors) and HL [19, 20]. However, limited evidence has proposed a significant direct association between diabetes self-care behaviors and HL. Therefore, the mediating role of psychological and socio-cognitive determinants required further investigation in cross-sectional studies or longitudinal studies [21, 22].

Poor self-care behavior has been implicated as the main barrier to control and improve type 2 diabetes in the Iranian population. Despite the importance of self-care skills and behaviors, little research has been undertaken to examine the mediating role of psychological and socio-cognitive determinants that influence self-care behaviors among patients with type 2 diabetes [23, 24]. Further, the interaction between HL skills development, knowledge, and self-care behavior has not been well investigated because it is unclear what potential predictors can influence patient self-care behavior to control diabetes targets [25]. Thus, there is an increasing need for assessments of potential predictors and their mediating role, which improve diabetes self-care behaviors and health outcomes in the medical care context. Although the benefits of strict diabetes control are evident, it is estimated that about 60% of patients with type 2 diabetes do not achieve the recommended diabetes control target [15, 26].

Based on the above-mentioned literature, a path analysis approach has been recommended to examine relationships of diabetes self-care behaviors with knowledge, health literacy, and key constructs of EPPM. Therefore, the present study aimed to determine the relationships among four potential constructs of EPPM and diabetes self-care behaviors (glucose self-control, foot care, physical activity, and a healthy diet) to understand potential predictors that may influence people with diabetes' health status and to investigate whether their HL and knowledge can account for part of the relation between diabetes self-care behavior and four message elements of EPPM theory. Hypotheses were based on the findings of the theoretical model proposed in previous studies [10, 19].

Methods

Study procedure

STROBE checklist was used for conducting this cross-sectional study. This study recruited 404 patients with Type 2 diabetes who were referred to the diabetes healthcare centers in Khaf, Iran, from January 2018 to April 2018. Healthcare centers in Iran are a public sector to provide free service of primary health care and public facility. These services are run by health care providers such as family health experts, physicians, midwives, nutritionists, and psychologists. Here, we examined the possible linkage between diabetes self-care behaviors, knowledge, health literacy, and constructs of the extended parallel process model (EPPM). All eligible participants were informed about the aim of the study, and specific terms related to health literacy and self-care behaviors aspects were also explained to ensure they would understand the meaning of wordings and decreased distractions. All eligible participants also completed the consent form and self-assessment questionnaires in a written format.

Participants and sampling

We calculated the required sample size based on a previous study [27] and the formula below [28]. The sample size was estimated to be 374 patients, due to the possibility of drop-outs from the study, a total of 404 patients were enrolled (d = 0.06; β = 80%; S = 0.58; α = 5%).

$$n = \frac{\left(z_{1-\frac{\alpha}{2}}\right)^2 (s)^2}{(d)^2}$$

Participants were included if they (a) had a diagnosis of type 2 diabetes, (b) were not suffering from diabetic foot disease, and (c) Consent to participate in the study. All eligible participants were randomly selected from diabetes healthcare centers in Khaf using a table of random numbers.

All enrolled participants filled out written informed consent and completed questionnaires. For illiterate participants, all questionnaires were completed by an interviewer through a face-to-face interview. Respondents were also assured that their information would remain confidential.

Measurement tools

The data collection instrument including four questionnaires, (a) a demographic questionnaire, (b) the Health Literacy for Iranian Adults questionnaire (HELIA), (c) diabetes knowledge, and (d) self-care behavior based on the EPPM.

(a) Demographics: In this study, demographic characteristics included age, sex, level of education, place of residence, and occupation.

(b) Health Literacy for Iranian Adults questionnaire (HELIA): It has a total of 33 items and is scored on a five-point Likert scale to measure individuals' ability in different dimensions of HL including reading skills (4 items), access (6 items), understanding information (7 items), assessment (4 items) and applying health information and decision-making (12 items). Functional literacy levels were classified into four scores. Scores 0 to 50, 50.1 to 66, 66.1 to 84, and 84.1 to 100 respectively, were labeled as inadequate, moderate, sufficient, and great HL, respectively [29]. The HELIA was developed and tested for reliability and validity by Montazeri et al. and was adapted for the Iranian context [29]. The average Content Validity Index (CVI), Content Validity Ratio (CVR) and reliability coefficients (Cronbach's alpha) for the HELIA were 89%, 88%, 0.98, respectively [29].

(c) Diabetes knowledge: We used 12 validated short questions to assess diabetes knowledge about self-care activities such as glucose self-control, physical activity, diet, cigarette smoking, and foot-care practice. Each question was measured in three options (wrong = 0, I do not know = 1, right = 2,). The average CVI, CVR, and the internal consistency for the diabetes knowledge were 88%, 89%, 0.80, respectively [27].

(d) Self-care behavior based on the EPPM: According to EPPM, perception of threat (including perceived susceptibility and severity) and efficacy (comprising response efficacy and self-efficacy) are key determinants of an individual's behaviors and intentions [10]. The validity and reliability of this questionnaire have been evaluated in the study of Najar et al. [27] which has had acceptable reliability, validity, and Cronbach's alpha, Constructs of perceived severity, perceived sensitivity, response efficiency, self-efficacy, and Cronbach's alpha of the total constructs were respectively 0.80, 0.81, 0.78, 0.79, and 0.85. In this study, Cronbach's alpha of the EPPM was 0.85.

We used five items to assess perceived susceptibility. Participants were asked to rate their belief about the degree of vulnerability, personal relevance, or risk of experiencing the diabetes threat (e.g., I am at risk of getting diabetic footprints). Perceived severity was determined using four items to assess participants' beliefs concerning the magnitude of the physical and economic threat that can occur (e.g., I believe that diabetic footprints are serious). Response efficacy contains 7 items to assess the effectiveness and feasibility of response in averting the threat (e.g., if I believe that using diabetic footprint recommendations increases my ability to care for my feet or I believe that eating five or more servings of fruits and vegetables during the week may control my blood - Glucose). Perceived self-efficacy contains 12 items. Participants were asked to rate their ability to perform the recommended diabetes care behavior to avert the threat or risk of diabetes (e.g., I can perform foot-care practice to prevent getting diabetes or I can follow a healthful eating plan or recommended diabetes medication?) [27]. All items were rated on a 5-step Likert type (completely disagree = 1, disagree = 2, no idea = 3, agree = 4, completely agree = 5). Self-care behavior for people with diabetes was examined using the 10-item Summary of Diabetes Self-Care Activities scales such as a healthy diet, blood glucose control, medications, physical activity, foot care practice, and cigarette smoking (e.g., have you smoked a cigarette—even one puff—during the past 7 days? or have you participated in at least 30 min of physical activity (Total minutes of continuous activity, including walking) – at least 3 times – during the past 7 days?). Each question was measured in dichotomous response (No = 1, Yes = 2) [30].

Statistical analyses

Data were analyzed with descriptive and analytical statistics using SPSS software version 22 (SPSS Inc., Chicago, IL, USA). We used AMOS software (version 22) to conduct the path analysis. We used maximum likelihood to estimate all models. The model path was considered a good fit if $x^2/df < 5$, adjusted goodness of fit index (AGFI) >0.8, root-mean-square error of approximation (RMSEA) < 0.08, goodness of fit index (GFI), relative fit index (RFI), incremental fit index (IFI), and comparative fit index (CFI) were > 0.9 [31–33]. In this study, we examined the following associations: 1) the key constructs of EPPM are associated with self-care behavior among patient with type 2 diabetes; 2) diabetes knowledge is directly associated with self-care behavior; 3) diabetes knowledge is indirectly associated with self-care behavior through constructs of EPPM and HL only; 4) HL is directly associated with diabetes self-care behavior, and 6) HL is indirectly related to diabetes self-care behavior through constructs of EPPM and knowledge. We examined hypothesis 1 in model 1, hypotheses 2 and 3 in models 1 and 2, and hypotheses 4 and 5 in model 2.

Results

Participant characteristics

In this study, the mean (±SD) age of participants was 57.36 (±12.02), and more patients (47.7%) were in the age group ≥60 years old. More participants were female (59.5%), married (96.5%), illiterate (68.9%), and housewives (57.9%). Most participants used tablets as their treatment method (84.32%) (Table 1).

Table 1 Frequency distribution of demographic factors

Variables		N	%
Gender	Female	238	59.5
	Male	162	40.5
Age group	≤ 49	119	30.2
	50–59	87	22.1
	≥ 60	188	47.7
Marital status	Married	360	96.5
	Single	13	3.5
Education level	Illiterate	270	68.9
	Elementary school	44	11.2
	Middle school	36	9.2
	Diploma	29	7.4
	Associate degree and Bachelor degree	13	3.3
Occupation	Housewife	230	57.9
	Employee	85	21.4
	Un Employee	82	20.7

Test of model 1

The path model for self-care behavior was tested. In the first path analysis model, we examined the relationship between knowledge and key constructs of EPPM (perceived susceptibility, perceived severity, response efficiency, and, self-efficacy). This model accounted for 20% of the variance for self-care behavior in people with diabetes (Fig. 1). The fitting indices of the path model showed a good fit (Table 2). As shown in Fig. 2, among EPPM's constructs, perceived susceptibility, response efficiency, and self-efficacy had a significant direct effect ($p < 0.05$) on self-care behaviors. Likewise, knowledge was the strongest predictor ($p < 0.001$), indicating about 20% of the total effects on diabetes self-care behavior (Table 3).

Test of model 2

In the second model, we also assessed the effect of HL on diabetes self-care behaviors. The fitting indices of the final model also indicate the suitability of the final measurement model in Table 2 ($p = 0.219$). The second model is shown in Fig. 2 and explained 32% of the variance for self-care behavior in people with diabetes. Our results showed that constructs of knowledge, HL, perceived susceptibility, perceived severity, response efficiency, and self-efficacy had a significant direct effect (74.52% of the total effects) on self-care behaviors. HL was the strongest predictor ($p < 0.001$), indicating about 32% of the total effects. The construct of knowledge had an indirect significant effect on self-care behavior that accounted for 25.48% of Total effects (Table 4).

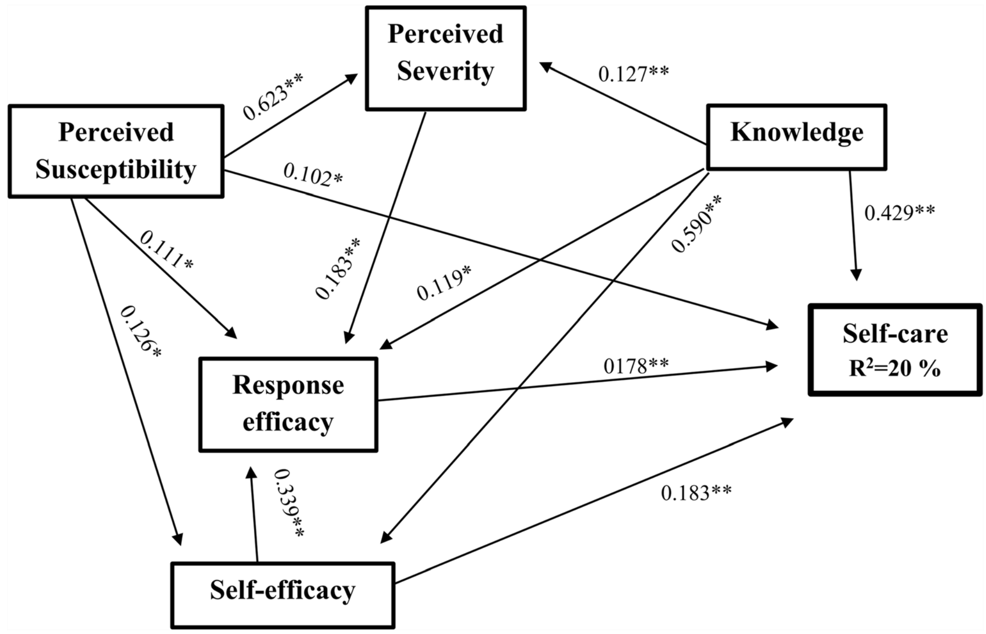

Fig. 1 The results of path analysis for EPPM (R^2: Squared Multiple Correlation, *$P < 0.05$, **$P < 0.001$)

Discussion

This study provides evidence for the relationship between diabetes self-care behavior, key constructs of EPPM, diabetes knowledge, and HL through path models 1 and 2.

Model 1

Our finding showed that path analysis was the good fit model to assess the association between the data and the key constructs of the EPPM model and knowledge, which shows all the significant pathways were in the expected direction.

Consistent with our hypothesis, diabetes knowledge emerged as the strongest direct path of self-care behaviors. This result is consistent with previous findings that observed diabetes knowledge is predictive of self-care behaviors. Our finding was consistent with the results of Ghanaian and Canadian adults' studies that their diabetes knowledge significantly and positively predicted self-care behaviors (blood sugar control, diet, and foot-care practice) [14, 34]. Likewise, diabetes knowledge significantly affected self - care behaviors through indirect pathways (severity, response efficacy, and self-efficacy). Our findings suggest that participants with greater diabetes knowledge, perceive greater importance of diabetes self-care, and their perceptions of self - efficacy increased, so, there was a higher likelihood of intending to perform self-care practice [35, 36].

In this study, testing the path model helped to elucidate the effects of perceived susceptibility, on diabetes self-care behaviors resulting from direct and indirect pathways (severity, self-efficacy, and response efficacy). Several previous studies, in which researchers examined only the indirect routes of perceived susceptibility on self-care behaviors, failed to observe the direct association [5, 14]. Both perceived severity and susceptibility are the subjective evaluation of the threat contained in the visual or factual message features [10]. Perceived severity was examined with an individual's beliefs about the significance and magnitude of the diabetes threat. Perceived susceptibility was measured based on an individual's beliefs about the likelihood that the diabetes threat will occur. Based on the definition of perceived susceptibility, our results showed that patients with higher susceptibility related to diabetes were more likely to perform self-care behaviors, and they more closely adhered to control glycaemia, take medication, use a healthy diet, do physical activity, and foot care. Several studies about perceived susceptibility revealed consistent results that the high susceptibility of chronic disease

Table 2 Models' evaluation overall fit measurements

Goodness of fit indices	Model 1	Model 2
X^2	3.839	8.275
df	3	6
X^2/df	1.280	1.379
P value	0.279	0.219
GFI	0.997	0.994
AGFI	0.978	0.973
RMSEA	0.026	0.031
IFI	0.999	0.998
PCLOSE	0.636	0.704
CFI	0.999	0.998
RFI	0.969	0.972

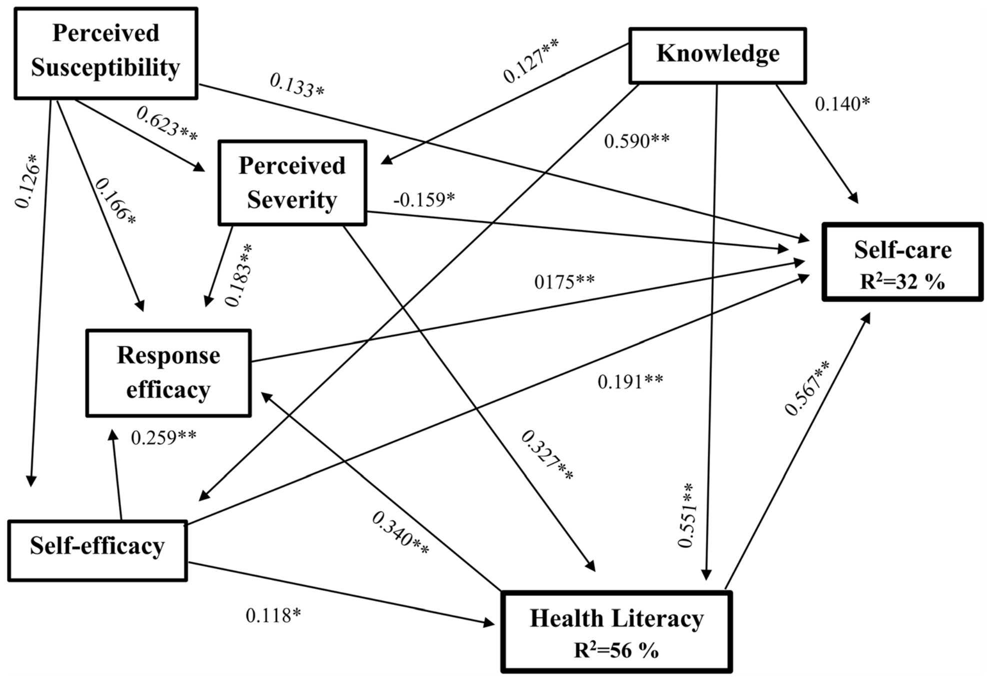

Fig. 2 The results of path analysis for EPPM and Health Literacy (R^2: Squared Multiple Correlation, *P < 0.05, **P < 0.001)

is an important reason for patients to care about their behaviors and health [9, 35, 36]. We also found that perceived severity may significantly reduce the level of diabetes self-care behavior. These findings were not supportive of other EPPM studies that identified perceived severity as the most influential construct to promote recommended behaviors [10, 37]. This could be that most of the participants (64%) had low to moderate belief about the severe and magnitude of the diabetes threat (develop heart disease, death, losing their leg).

In the present study, self-efficacy was a significant determinant of the level of diabetes self-care behavior because most of the participants (71%) had moderate to high ability to perform the recommended self-care behaviors (glycemic control, healthy diet, foot care practice) and they have appropriate self-confidence to continue their behavior in different situations. This result is consistent with recent studies that have demonstrated a strong predictive power for self-efficacy across both ethnicity/race with diabetes [16, 38, 39]. However, the

Table 3 Direct and indirect effects of EPPM constructs (Model 1)

Determinants or Predictors	Causal Effect		
	Direct	Indirect	Total effects
→Knowledge → Perceived Severity	0.127**	–	0.127
→Knowledge → Self-efficacy	0.590**	–	0.590
→Knowledge → Response efficacy	0.119*	0.223**	0.342
→Knowledge → Self-care	0.429**	−0.047	0.382
→Perceived Susceptibility → Perceived Severity	0.623**	–	0.623
→Perceived Susceptibility → Self-efficacy	0.126*	–	0.126
→Perceived Susceptibility → Response efficacy	0.111*	0.156*	0.268
→Perceived Susceptibility → Self-care	0.102*	0.025	0.127
→Perceived Severity → Response efficacy	0.183**	–	0.183
→Perceived Severity → Self-care	–	0.033*	0.033
→Self-efficacy → Response efficacy	0.339**	–	0.339
→Self-efficacy → Self-care	0.183**	0.060*	0.243
→Response efficacy → Self-care	0.178**	–	0.178
Total causal effect	3.11	0.45	3.56
Percantage of direct and indirects effects	3.11/3.56 = 87.36%	0.45/3.56 = 12.64%	

*P < 0.05, **P < 0.001

Table 4 Direct and indirect effects of EPPM constructs and health literacy (Model 2)

Determinants or Predictors	Causal Effect		
	Direct	Indirect	Total effects
→Knowledge → Self-efficacy	0.590**	–	0.590
→Knowledge → Perceived Severity	0.127**	–	0.127
→Knowledge → Health Literacy	0.551**	0.111*	0.662
→Knowledge → Response efficacy	–	0.378**	0.378
→Knowledge → Self-care	0.140*	0.242**	0.382
→Perceived Susceptibility → Self-efficacy	0.126*	–	0.126
→Perceived Susceptibility → Perceived Severity	0.623**	–	0.623
→Perceived Susceptibility → Health Literacy	–	0.219**	0.219
→Perceived Susceptibility → Response efficacy	0.166**	0.107**	0.273
→Perceived Susceptibility → Self-care	0.133*	0.001	0.134
→Self-efficacy → Health Literacy	0.118*	–	0.118
→Self-efficacy → Response efficacy	0.259**	0.040*	0.299
→Self-efficacy → Self-care	0.191**	0.067*	0.258
→Perceived Severity → Health Literacy	0.327**	–	0.327
→Perceived Severity → Response efficacy	–	0.111**	0.111
→Perceived Severity → Self-care	−0.159*	0.185**	0.026
→Response efficacy → Self-care	0.175**	–	0.175
→Health Literacy → Response efficacy	0.340**	–	0.340
→Health Literacy → Self-care	0.567**	–	0.567
Total causal effect	4.274	1.461	5.735
Percantage of direct and indirects effects	4.274/5.735 = 74.52%	1.461/5.735 = 25.48%	

$^{*}P < 0.05$, $^{**}P < 0.001$

magnitude of the associations suggests that further study of the predictors of and barriers to self-care behaviors among diverse populations.

Also, the response efficacy emerged as the significant direct path of self-care behaviors among people with diabetes when mediates the impacts of the other constructs of EPPM, particularly self-efficacy, severity, susceptibility. In this study, most participants believed that diabetes self-care behaviors and diabetes self-management education are very effective in controlling diabetes and that they are easy to use, which was in accordance with more studies of patients with chronic disease [16, 36, 40].

We found that when the threat and efficacy message is high, patient intentions were greater regarding the self-care behaviors and complies with the recommendation. Most of the recent study found that the high-threat/high-efficacy message could be manipulated as attributes of the message, observed that high levels of perceived threat and efficacy were positively associated with behavioral and cognitive message acceptance [1, 9, 10, 41]. Likewise, more studies found that the actual behavior and highest behavioral intentions were highest among people with high threat/high efficacy messages [9, 10, 36].

Model 2

Diabetes is a chronic disease associated with the development of serious complications, and its effective control and to have some good self-care behaviors, patients would require sufficient levels of diabetes knowledge and HL regarding self-care, a concept that can increase, good dietary pattern, adherence to medications and physical activity among people with diabetes. Therefore, we also examined the effect of HL on diabetes self-care behaviors using model 2. This model showed a good fit between the data and the key constructs of the EPPM, HL, and knowledge. Consistent with our hypothesis, the results from the path analysis showed significant direct and indirect (severity, self-efficacy, and health literacy) effects of diabetes knowledge on self-care behaviors in Model 2.

This shows that the more knowledge of people with diabetes, the more likely they are to engage in diabetes management and self-care behaviors. This result is consistent with the previous findings that observed diabetes knowledge significantly and positively predicted self-care behaviors (blood sugar testing, diet, and foot-care), HL skills, and self-efficacy [34–36]. A unique aspect of these results was that knowledge appears to exert its strong effect on self-care behaviors through HL and self-efficacy.

HL emerged as the strongest direct path of self-care behaviors when it mediates the effects of knowledge, perceived severity, and self-efficacy. Several previous studies, in which researchers examined only the indirect routes of HL on self-care behaviors, failed to observe the direct association [17, 34, 35]. These findings indicated that HL is not directly influenced by self-care behaviors, but probably exerts its effects through knowledge, perceived severity, and patients' self-efficacy [11, 34, 35]. Likewise, HL indirectly predicted diabetes self-care behavior through constructs of efficacy. In this study, the higher HL associated with higher diabetes self-care behaviors, and this issue may result in increased patient efficacy to manage their diabetes. In support of this finding, several studies showed that having adequate HL is related to self-care behaviors for chronic disease [17, 34]. It is concluded that when a patient has adequate HL and their effective role in controlling diabetes, it will be more likely for them to engage in diabetes self-care behaviors.

This study has some limitations, which are worth noting. It was carried out at a single health center in northeastern Iran, so the generalization of our findings to other communities across the nation would need to be done cautiously. However, we highlight the need to be cautious in interpreting the effect of the construct of EPPM, HL, and knowledge across diverse populations. Second, the results of the present study were assessed using a self-report questionnaire, which may have led to the possibility of biased results in mean scores. Third, we did not examine the effects of diabetes complications and its duration that may influence self-care behaviors, diabetes knowledge, and health literacy. Although our finding is consistent with previous reports, these factors could be included when assessing diabetes self-care behaviors, HL, and diabetes knowledge. Finally, in this study, there was a significant association between HL and perceived susceptibility, and between knowledge and susceptibility. Of note is that race/ethnicity was related to individuals' knowledge and health literacy. In this study, it is possible, other unmeasured parameters could be mediating this association such as social and personal motivation and patient-provider communication. Therefore, further studies with longitudinal data are required to better understand the mechanisms through which knowledge and HL are associated with diabetes self-care behaviors.

Conclusion

The effectiveness of EPPM for identifying the potential determinates or predictors of diabetes self-care behaviors was empirically supported. This study highlights the impact of an individual's perceived susceptibility, efficacy, self-efficacy, knowledge, and HL on strengthening the level of diabetes self-care behaviors. It is concluded that when a patient has a higher perceived threat and efficacy to diabetes effect, and when a patient has deep diabetes knowledge and HL about self-care methods and their effective role in diabetes management, it will be more likely for them to engage in self-care behaviors practices.

Practical implications

This study is one of the first to test the effectiveness of four message constructs of EPPM improving the diabetes self-care behaviors. Evaluating the effectiveness of the theoretical model in different communities is essential in moving the theory forward and understanding the potential determinates in successful interventions. A unique aspect of this study was that diabetes knowledge and health-related HL were tested to find out how they change the threat and efficacy message in EPPM and support patient's abilities and beliefs to promote self-care behaviors. Further, identification of a crucial compound that influences diabetes self-care behaviors is practical for health promoters and public health educators to consider knowledge, HL, threat, and health-related efficacy in designing specific self-care practices and interventions among patients with chronic disease such as the diabetic and hypertensive patient.

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Compliance with ethical standards

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

Ethical consideration This study is based on a research project approved by the Student Research Committee of Torbat Heydariyeh University of Medical Sciences with the code of ethics IR.THUMS.REC.1395.57. All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable.

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