

Cognitive predictors of physical activity behaviors among rural patients with type 2 diabetes: applicability of the Extended Theory of Reasoned Action (ETRA)

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Background: This study aims to examine the cognitive-behavioral determinants of physical activity behaviors (PABs) of patients diagnosed with type 2 diabetes.

Subjects and methods: In this cross-sectional study, census sampling was employed to enroll 120 rural patients with type 2 diabetes in the Chalderan County in 2015. To collect data, a valid and reliable instrument, based on the Extended Theory of Reasoned Action (ETRA) constructs, was used. Data were analyzed by SPSS 21 software using descriptive and inferential statistical methods.

Results: Using the one-way ANOVA test, it was found that PABs had statistically significant correlation with all ETRA constructs except subjective norms ($P=0.574$). Knowledge ($P=0.015$), self-efficacy ($P<0.001$) and behavioral intention ($P<0.001$) had a significant association with PABs, respectively. Also, ETRA structures were able to reflect 41.0% of the behavioral changes. Among structures, knowledge ($P=0.014$), self-efficacy ($P<0.001$), and behavioral intention ($P=0.020$) were significant predictors of PABs ($R^2=0.414$).

Conclusions: Health care providers may consider the ETRA an appropriate framework to design educational interventions aimed at improving PABs among rural patients with type 2 diabetes.

Keywords: diabetes mellitus, type 2, physical activity, self care

Introduction

Diabetes is one of the most common metabolic diseases worldwide and also in Iran.¹ According to the WHO report of 2016, there are approximately 422 million diabetic adults globally,² and it is estimated that this number would reach 438 million in 2030; this is due to population aging, population growth, and lifestyle changes.³ It, also, imposes financial, psychological, and social costs on individuals, families, and society.⁴

The WHO report in 2012 revealed that approximately 1.50 million deaths were directly caused by diabetes and another 2.20 million deaths were pertained to high blood glucose.⁵ In addition to the increased mortality, diabetes can lead to decreased physical function, negative influence on mental health, chronic diseases such as cardiovascular disease,^{6,7} and a decreased quality of life of the patients.⁷ To prevent the complications of diabetes, the use of nonpharmacological approaches such as healthy nutrition education and regular physical activity can be helpful.⁸

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The sedentary lifestyle is one of the most important modifiable factors of diseases such as diabetes.⁹ Evidence indicates that physical activity, in addition to a reduction in metabolic risks, can be effective in weight management, improving blood glucose and lipid profiles in diabetic patients. Furthermore, some studies suggest long-term effects of physical activity in controlling diabetes.¹⁰ Despite the positive effects of physical activity in the prevention and control of diabetes, some studies show that diabetic patients have less mobility compared to healthy people.¹¹ This sedentary lifestyle can be caused by various factors. Identifying and understanding the factors affecting the lifestyle of diabetic patients can be helpful to health care providers in the design and implementation of preventive interventions.¹²

Previous studies have suggested using behavior change theories and models to create and maintain physical activity due to its complexity can be helpful.¹³ The theories can provide a rational framework for designing interventions and also act as a guide for their evaluation.¹⁴ The Theory of Reasoned Action (TRA) focuses on the individual and interpersonal factors, such as attitudes, subjective norms, and the way they influence behavioral intentions and, in turn, behaviors.¹⁵ This theory is successful in predicting behaviors that are fully under the voluntary control of people but is not sufficient to examine the behaviors by individuals that are not fully volitional.¹³ Owing to this deficiency, the TRA has been further developed by adding the construct of perceived behavioral control (PBC). PBC is defined as the perceived ease/difficulty of performing an action.¹⁶ Although Ajzen argues that self-efficacy and PBC are synonymous, Bandura believes that the concept of self-efficacy is broader than PBC.¹⁷ Moreover, the results of several studies have shown that self-efficacy could be better than PBC in predicting behavioral intention and behavior. According to these findings, the researchers used the theory of self-efficacy along with other structures of the TRA and named it the Extended Theory of Reasoned Action (ETRA). These studies have shown that the TRA, along with self-efficacy, can be valuable in predicting behavioral intentions and behaviors such as substance abuse prevention, and oral health.¹⁸ Likewise, the study conducted in Iran by Didarloo et al¹⁹ among women with type 2 diabetes reported that significant correlation existed between independent constructs and model-related dependent constructs. For instance, the presence of a significant association between attitudes and intention to perform self-care among diabetic women

($\beta=0.199$, $p=0.001$), as well as ETRA model along with three model constructs (attitude, subjective norms, and self-efficacy), explained 41.5% of variance of intentions and 25.3% of variance of actual behavior.

This study was performed to assess the cognitive and demographic variable predictors of physical activity behaviors (PABs) among patients with type 2 diabetes in a rural area using ETRA. The identification of the determinant factors may be beneficial in developing interventional measures aimed at promoting physical activity.

Subjects and methods

Research design

This cross-sectional study was performed on rural patients with type 2 diabetes in Chalderan city, West Azerbaijan Province, Iran. The study period was 3 months: May to July 2015. The target population comprised all type 2 diabetic patients within that area.

Setting and sample

According to the available medical records in the health network, 139 patients with type 2 diabetes lived in the rural area of Chalderan. However, 15 people were excluded from the main study due to their participation in the pilot study and four refused to take part. Therefore, the study was conducted on 120 participants.

The inclusion criteria for the study were: living in a rural area in Chalderan County; being over 30 years old; having a medical record as a type 2 diabetes patient in the health network. Exclusion criteria were: having other types of diabetes (type I or pregnancy) and refusal to participate in the study.

Data collection and instruments

The data collection tools were valid and reliable questionnaires.¹³ As this instrument was developed in Persian, to be used among patients with type 2 diabetes, no prior specific change was required. An expert panel (including two health educationists and two endocrinologists) confirmed its validity. In order to assess the reliability, a pilot study was conducted on 15 patients with type 2 diabetes, who were not included in the final sample. The Cronbach's alpha of the scales was calculated in the pilot and main study as well as the scales, number of items, reliability coefficients, and possible ranges of the constructs (Table 1).

Table 1 Descriptive statistics for Extended Theory of Reasoned Action (ETRA) variables

ETRA constructs	Number of items	Possible range	Mean (\pm SD)	Cronbach α in the pilot study	Cronbach α in the main study
Knowledge	11	0–22	7.40 (2.9)	0.79	0.77
Attitude	4	4–20	10.48 (\pm 1.9)	0.81	0.85
Subjective norms	4	4–20	11.19 (\pm 2.8)	0.88	0.83
Self-efficacy	4	4–20	10.83 (\pm 2.8)	0.87	0.92
Behavioral intention	2	2–10	5.58 (\pm 2.1)	0.90	0.95

Note: The Cronbach's alpha is measured 0.77–0.95 for the ETRA.

With respect to instrument, it is noteworthy that demographic characteristics included six items: gender, age groups (30–39, 40–49, \geq 50), level of education, marital status, job, household monthly income. Knowledge of diabetes was measured using 11 multiple-choice items. An example of the items is: “What are the early complications of diabetes?” Correct answers scored 2, incorrect ones 0; and “do not know” response, 1. The possible scores ranged from 0 to 22.

The ETRA questionnaire included four constructs: attitude (eg, “I think that doing regular daily physical activity can lead to regulated blood sugar levels, improved health and happiness of the people”), subjective norms (eg, “my family supports me in doing appropriate exercise”), self-efficacy (eg, “I am able to do physical activity every day”), and behavioral intention (eg, “I intend to perform physical activity regularly within the coming month”). For all four constructs, the items were rated on a 5-point Likert scale ranging from 1 to 5 (1=totally disagree through to 5=totally agree). The minimum score in structures of attitude, subjective norms, and self-efficacy was 4 and the maximum 20, whereas the minimum score in the behavioral intentions was 2 and the maximum 10.

Finally, to assess the levels of diabetes self-management, the summary of diabetes self-care activities measure was used.²⁰ Physical activity behaviors were measured with the two items following :

- 1) On how many of the last SEVEN DAYS did you participate in at least 30 minutes of physical activity? (Total minutes of continuous activity, including walking).
- 2) On how many of the last SEVEN DAYS did you participate in a specific exercise session in (as riding a bike, swimming . . .) other than what you do around the house or a as part of you work ?

In this instrument, the participants declared the number of days they did the recommended physical activities over the past seven days. Response categories included a 7-point scale ranging from 0 to 7. Total possible scores ranged from 0 to 14, in which higher scores were representative for higher PABs on the part of the participants.

Statistical analysis

Data were analyzed by applying SPSS software (Version 20.0, Chicago, IL, USA) and presented with the frequency and mean (\pm SD) of the variables. The possible differences between PABs with demographic variables which were dichotomous were analyzed by independent t-test. In order to determine whether there were any significant differences among the means of three or more independent groups, one-way ANOVA was used.

To assess the differences among ETRA structures which were more than two categories regarding PABs, one-way ANOVA was applied. Additionally, a hierarchical multiple linear regression analysis was utilized to illustrate the variations in PAB scores on the basis of ETRA constructs. Hierarchical regression is a method to demonstrate if the variability of one's interest explains a statistically significant amount of variance in your dependent variable after accounting for all other variables. Predictors for PABs were classified in two different blocks according to their natures: 1 (demographic characteristics block: age group, level of education, household monthly income, and duration of disease; 2 (ETRA block: This block comprised of the five different constructs of ETRA. A P-value $<$ 0.05 was considered to indicate statistical significance.

Results

A total of 120 individuals participated in the study. Of these, 53.3% of the participants were female and 46.7% male. The majority (40.0%) were in the age group of 40 to 49 years,

while 28.8% of the participants were in the age group of 30 to 39 years, and 34.2% were at the age of 50 or higher. Regarding the educational status, 34.2% of respondents were illiterate, 31.7% and 33.3% were literate up to the elementary and secondary levels, respectively. Around 12.5% reported that their household monthly income was less than 313 dollars, 66.7% was 313 to 470 dollars, and 20.8% was more than 470 dollars. The duration of the disease in 23.3% of the subjects was <5 years, in 52.0% was 5 to 10 years, and in 24.4% was >10 years (Table 1).

Examining the cognitive behavioral determinants of PABs of 120 patients diagnosed with type 2 diabetes, the present study revealed that the mean (\pm SD) physical activity of the participants was 1.20 (\pm 1.9) times per week. Demographic characteristics of the participants are demonstrated in Table 2. In accordance with ANOVA test between age categories and PABs, there was a significant association ($P=0.032$). Also, the findings demonstrated a statistically significant association between PABs and education level. Hence, individuals with lower education levels in comparison with those with higher education had lower physical activity ($P<0.001$) (Table 2).

Using the one-way ANOVA test, it was found that PABs had statistically correlation with all ETRA constructs except

for subjective norms ($P=0.574$). Knowledge ($P=0.015$), self-efficacy ($P<0.001$), and behavioral intention ($P<0.001$) had a significant association with PABs, respectively. In other words, based upon multiple comparison tests of post hoc, the Scheffé test, and test of homogeneity of variance ($P<0.05$), there was a statistically significant difference in PABs of subjects when comparing patients with increased amount of physical activity (2 days and more) with those with no or only 1-day activity.

For example, in self-efficacy dimension, in subgroups of 0–2 ($P=0.077$), 0–3 ($P=0.001$), 0–4 ($P=0.004$), 1–3 ($P=0.002$), and 1–4 ($P=0.010$), statistically significant differences were observed. In behavioral intention dimension, in subgroups of 0–3 ($P=0.020$), 0–4 ($P=0.002$), 1–3 ($P=0.006$), and 1–4 ($P=0.001$), the differences were significant. Also in knowledge dimension, in subgroup 0–3 ($P=0.050$), the difference was significant. More explanations of subgroups' physical activity are illustrated in Table 3.

Table 4 represents the hierarchical multiple linear regressions for ETRA constructs and PABs. According to the analysis, demographic variables of the participants approximately reflected 16.10% of the observed variance in PABs, which was statistically significant at 0.05 levels. At the first step, the variables of age group and level of education

Table 2 Demographic characteristics of the participants and their association with physical activity behaviors

Variables	Categories	N (%)	Mean (\pm SD)	F	Effect size	P-value
Age groups	30–39	31 (28.8)	1.64 (\pm 1.2)	3.55	0.057	0.032 ^Ω
	40–49	48 (40.0)	1.14 (\pm 1.2)			
	≥50	41 (34.2)	0.92 (\pm 0.9)			
Gender	Male	64 (53.3)	1.14 (\pm 1.1)	0.44	0.003	0.590 ^{ΩΩ}
	Female	56 (46.7)	1.26 (\pm 0.2)			
Education level	Illiterate	42 (34.2)	0.92 (\pm 0.9)	10.79	0.156	0.001 ^Ω
	Elementary	38 (31.7)	0.84 (\pm 1.0)			
	Secondary	40 (33.3)	1.85 (\pm 1.2)			
Household monthly income	<313 dollars	15 (12.5)	1.07 (\pm 1.0)	0.925	0.016	0.410 ^Ω
	313–470 dollars	80 (66.7)	1.48 (\pm 1.1)			
	>470 dollars	25 (20.8)	1.48 (\pm 1.3)			
Duration of disease	Less than 5 years	28 (23.3)	1.32 (\pm 1.3)	0.917	0.015	0.402 ^Ω
	5 to 10 years	63 (52.5)	1.06 (\pm 1.1)			
	More than 10 years	29 (24.2)	1.37 (\pm 0.9)			

Notes: ^Ωp-value was calculated based on ANOVA test, ^{ΩΩ}p-value was calculated based on t-test.

Table 3 The number of activity days for each subgroup

Subgroups	0	1	2	3	4
Days of doing activity	Zero day	One day	Two days	Three days	Four days

revealed significant associations with PABs. Similarly, the ETRA constructs were responsible for 41.40% change in the observed variance which was statistically significant ($P < 0.001$). Knowledge ($\beta = 0.205$), self-efficacy ($\beta = 0.306$), and behavioral intention ($\beta = 0.182$) indicated significant associations with PABs. Among the significant structures, self-efficacy ($\beta = 0.306$) was the strongest predictor of PABs.

Discussion

This study was carried out to examine the cognitive determinants of PABs among the patients diagnosed with type 2 diabetes using ETRA in a rural area in Chalderan city, Iran.

The findings of the study indicated that the average PABs were 1.20 times per week among the participating patients suffering from type 2 diabetes which represents the inactivity of the patients. The diabetic patients should perform moderate-intensity physical activities such as hasty walking, swimming, and bike riding for at least 150 mins in the week for at least three nonsequential days.²¹ In line with these findings, Baji et al²² reported that behaviors of physical activity were weak in patients with type 2 diabetes. However, the results of the studies indicate that regular physical activity as

a self-care behavior could have an important role in controlling the complications of diabetes.^{23,24} Likewise, according to a meta-analysis, physical activity and risk of type 2 diabetes have an inverse correlation; it is worth mentioning that reduced adiposity might mediate the issue.²⁵

Therefore, it seems necessary to focus on physical activity and to identify the factors affecting it. As a result, it can be helpful in designing effective interventions to promote physical activity in type 2 diabetes patients.

It was found that patients of older ages (≥ 50) had a lower average of PABs. It is similar to the results of previous studies in other countries²⁵ and in Iran.¹³ These findings suggest that increasing age is associated with decreasing self-care behaviors to avoid making causal implications. Consequently, it is recommended to make educational interventions aimed at improving PABs in diabetic patients of older ages in health care centers and clinics.

In the current study, PABs were higher among literate patients. This finding was consistent with previous studies.¹³ One of the reasons for the lower level of physical activity in people with lower educational level can be that the level of health literacy among uneducated people is low. A study showed that age group (below or above 65 years old) was the most important predictor of overall activity level. It is to say that 4.8% of the variance in the physical activity level and self-efficacy as a correlate is positively associated with adoption and maintenance of physical activity.²⁶ In another study, low education was associated with a lack of moderate-to-

Table 4 Hierarchical regression analysis to predict physical activity behaviors

Step/Variable	Step 1			Step 2		
	Standardized beta coefficient	P-value	R ²	Standardized beta coefficient	P-value	R ²
(1) Age groups	-0.210*	0.020	0.161	-0.152	0.061	0.414
Gender						
Level of Education	0.308*	0.001		0.209*	0.008	
Household monthly income	0.054	0.519		0.014	0.947	
Duration of disease	0.059	0.495		0.103	0.261	
(2) Knowledge			0.205*	0.014		
Attitude			0.122	0.108		
Subjective norms			0.043	0.510		
Self-efficacy			0.306*	0.001		
Behavioral intention			0.182*	0.020		

Note: *P-value is significant at the less than 0.05.

vigorous physical activity, whereas high education was linked with a lack of light-intensity physical activity as well as high sedentary time, especially, during weekdays.²⁷ Furthermore, according to Sun et al²⁸ education has a positive association with prior knowledge and health literacy. These results emphasize the need to design and implement training programs for people with low literacy levels in order to improve awareness about self-care behaviors.

A statistically significant association was found between knowledge ($P=0.014$) and PABs. According to the findings, knowledge was the second best-reflecting factor of PABs. This finding proves that a patient with type 2 diabetes with more necessary knowledge is more likely to perform PABs. Low knowledge of health-promoting behaviors can affect the control of the disease.²⁹ In concert with this study, Didarloo et al¹⁹ reported that knowledge was one of the strongest predictors of self-care behaviors among diabetic patients. In other studies, Corbett³⁰ reported that knowledge was an important factor in controlling diabetes. These findings confirm the need for developing and conducting educational programs to increase people's knowledge about ways to control diabetes. Therefore, it is recommended that different programs, such as campaigns, be adopted to improve patients' knowledge about the disease.

Besides, according to the findings of the present study, self-efficacy is found to be the strongest predictor of intention to physical activity and PABs. In other words, the findings show that when an individual believes in his/her ability to perform PABs, he/she will be more interested in adopting them. Consistent with this, Didarloo et al¹⁹ reported that self-efficacy was the strongest predictor of behavioral intention and self-care behaviors among diabetic patients. ALAboudi et al²⁹ also found that self-efficacy was a significant predictor of self-care behaviors and blood glucose control. The previous study has shown that the promotion of self-efficacy may improve health-promoting behaviors among different people.³¹ Correspondingly, in another study, Lin et al³² indicated that diabetes self-efficacy might have an indirect effect on glycemic control through diabetes self-management. Considering the promotion of self-efficacy as a vital approach in planning diabetes control, educational interventions may promote PABs among diabetic patients.

As mentioned in the result section, the variables of age group and level of education had significant associations with PABs and demographic variables of the participants could reflect more than 16% of the observed variance in PABs. Yet, in the second step, ETRA constructs could predict 41.4% of the changes in the PABs, which was

statistically significant ($P<0.001$). Using ETRA among adolescents, Tavooosi et al¹⁸ conducted a research study on drug abuse prevention behaviors; ETRA explained 28.0% of the variance of the behaviors and 36.0% of the variance of the behavioral intention. In addition, Kuo-chang et al³³ realized that ETRA constructs could predict behavioral intention and behaviors better than the theory of reasoned action. Considering the usability of ETRA in predicting PABs in the present study, the researchers of this study may suggest that the ETRA might be a potential methodology in developing educational programs aimed at physical activity promotion among diabetic patients.

Limitations

A limitation of this study was the use of a self-reported questionnaire that could be subject to response bias. Another limitation was doing research only on type 2 diabetes patients, which may affect the generalizability of the results. Additionally, PABs were measured only over a period of 7 days, which hardly represent enduring behavior.

Conclusion

The findings of the current study showed that ETRA was a beneficial model in predicting cognitive determinants of PABs among rural type 2 diabetic patients. The PABs among rural type 2 diabetic patients in Chalderan city were low. Therefore, conducting educational intervention efforts aiming at PAB promotion is suggested. Health care providers and community health nurses in rural areas should pay much more attention to PABs among rural type 2 diabetic patients and design specific health educational programs for this population while using promising health education theories like ETRA. In order to increase motivation or intention to perform physical activity among diabetic patients, health care providers should first focus on the diabetics' self-efficacy, then intervene in subjective norms, attitudes, and other factors.

Ethics approval and consent to participate

The study protocol was reviewed and approved by the Ethics Committee of Tabriz University of Medical Sciences. Written informed consent was obtained from all participants after a full explanation of the nature, purpose, and procedures used for the study.

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Disclosure

The authors report no conflicts of interest in this work.

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