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Fruit and vegetable consumption in diabetics patients: Effect of pender health promotion model (HPM) intervention

Batool Zeidabadi[1,2], Reza Sadeghi[3], Seyed Vahid Ahmadi Tabatabai[4], Mohammad Moqaddasi Amiri[3], Parniya Abolghaseminejad[3], Khadijeh Ahmadzadeh[1]

Abstract:

BACKGROUND: This study was aimed to investigate the effect of the intervention based on Pender's health promotion model (Pender's HPM) to improve the consumption of fruits and vegetables in diabetic patients.

MATERIALS AND METHODS: The present study was quasi-experiment community-based research conducted on 112 diabetic patients in Sirjan City. Eligible diabetic patients were randomly divided into two experimental and control groups. The data were collected by two questionnaires, Behavioral Risk Factor Surveillance System and the researcher-made based on Pender's HPM. In order to compare qualitative variables between two groups, Chi-square test was performed. *P* value <0.05 was considered significant.

RESULTS: The findings showed that there is a significant difference in the consumption of fruit juice in men and women (*P* value = 0.016). In this study, the perceived obstacles structure and interpersonal influences structure was effective on the consumption of vegetables and salad in diabetic patients before and after the educational intervention.

CONCLUSION: Perceived benefits and interpersonal and situational influencers are effective on the consumption of fruits and vegetables in diabetic people and health planners should design educational interventions in order to increase the consumption of fruits and vegetables in the target group by considering these effective determinants.

Keywords:

Diabetes type 2, diabetic patients, fruit and vegetables consumption, Pender's health promotion model

[1]Sirjan School of Medical Sciences, Sirjan, Iran, [2]Department of Health Education and Promotion, Social Determinants of Health Research Center, School of Public Health, Shahid Sadoughi University of Medical Sciences, Yazd, Iran, [3]Department of Public Health, Sirjan School of Medical Sciences, Sirjan, Iran, [4]Department of Assistant Professor Health Education and Promotion, School of Public Health, Kerman University of Medical Sciences, Kerman, Iran

Address for correspondence:
Dr. Khadijeh Ahmadzadeh, Sirjan School of Medical Sciences, Sirjan, Iran.
E-mail: khj_ahmadzadeh@yahoo.com

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Introduction

Type 2 diabetes (T2D) is a complex multifactorial disease afflicting an increasing number of patients worldwide and put a huge burden on healthcare systems and poses a serious threat to human health.[1] One of the public health concerns in the world, in addition to the high prevalence and incidence of diabetes, is its serious complications.[2,3]

Currently, the projection of having diabetes will rise from one in 11 adults in 2015 to one in 10 adults by 2040, of which 90% have T2D. Issued in 2019, the International Diabetes Federation estimated that the number of global diabetes individuals aged 20–79 was 463 million and will increase to 578 million by 2030, of which 75% are in low-to-middle-income countries.[4]

According to the World Health Organization report, four to five percent of the health and treatment budget is related to diabetes-related diseases, and the medical cost of people with diabetes is two to five

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times more than the medical cost of healthy people.[5] In Iran like many other countries, diabetes is considered as one of the leading causes of mortality and also with high economic costs. Studies have shown that the direct and indirect costs of a diabetic patient in Iran are about 2.5 times more than a healthy person in the same condition.[6] Many non-communicable diseases, especially diabetes, are directly associated with nutrition, in a way that food imbalances helped to the high prevalence of diabetes in communities.[2]

According to the World Health Organization estimates, one of the five main factors in creating the global burden of diseases is the reduction of fruit and vegetable consumption, and an important risk factor that can be modified, which contributes to the increase in the global burden of chronic diseases, including diabetes.[7]

Daily consumption of two to four units of fruits and three to five units of vegetables is very important for individuals' health.[8]

Regarding this issue, WHO has advised people to consume 400 g or more portions of fruits and vegetables a day.[9] Also, in order to control and prevent diabetes and its complications, diabetic patients are advised to consume high-fiber foods such as vegetables and fruits.[10] In a study in 2018, the consumption rate of fruits and vegetables was less than the recommended. For example, in 52 low-middle-income countries, more than 75% of people consumed less than recommended.[11] In Iran, the mean consumption of fruits is 142 g a day, and the mean per capita consumption of vegetables is 286 g a day.[12]

Based on Pender's model, diabetics patients can consume fruits and vegetables when they perceive the benefits of doing so and also understand the barriers preventing them from the consumption of fruits and vegetables in a way that the ability to overcome the barriers to consume fruits and vegetables is positively and significantly associated with the increased consumption of fruits and vegetables. In addition, interpersonal influencers and the most important of which are family, friends, and health practitioners can have a positive effect on fruit and vegetable consumption. Along with this, self-efficacy is a determining factor in changing health-related behaviors.[13] In a study, the positive effect of Pender's HPM on improving proper nutrition methods in diabetic patients has been confirmed in a descriptive study on fruit and vegetable consumption in diabetic patients, and self-efficacy and perceived barriers were the strongest predictors for fruit and vegetable consumption in diabetic patients. Therefore, it is very important that during the design of health education and health promotion interventions in diabetic people, these effective determinants are considered in order to increase fruit and vegetable consumption.[4]

Due to the increase in the prevalence of diabetes in Iran and the lower consumption of fruits and vegetables in diabetic people than the global recommended amount and considering that limited studies have been conducted about fruit and vegetable consumption in diabetic patients in the southeast of Iran, it is necessary to develop an intervention program to increase fruit and vegetable consumption in order to reduce the growth of type 2 diabetes. Increasing fruit and vegetable consumption may be considered an effective strategy for reducing the incidence of chronic diseases, including diabetes, but it is unclear what the level of evidence for potential protection associated with fruit and vegetable consumption is and what outcomes are most affected. Therefore, this study was aimed to investigate the effect of the intervention based on Pender's HPM with the consumption of fruits and vegetables in diabetic patients.

Materials and Methods

Study design and setting

The current study is a quasi-experimental community-based research. The studied population who were patients with type 2 diabetes referred to the specialized diabetes clinic of Sirjan city in the southeast of Iran were divided into two groups (intervention and control) and the study was done in two stages (before and after the intervention). In the specialized diabetes clinic, there were two independent physicians for diabetic patients. In order to avoid the effect of the intervention spreading, people with cases in the first physician were included in the intervention group and people with cases in another diabetes physician's office were included in the control group. Diabetic subjects were included in the study in a simple random manner.

The including criteria were willingness to participate in the study, being literate in reading and writing, having an appropriate physical condition, and the excluding criteria were unwillingness to continue cooperation and creating restrictions on the consumption of fruits and vegetables and severe complications of diabetes (digestive problems), kidney failure, warfarin use, etc.

Study participants and sampling

Based on previous studies on the use of the Pender model in diabetic patients,[14] the mean and standard deviation of the perceived benefit score in the intervention group was m1:3.63, sd1:0.34 and the control group was m1:3.45, sd1:0.39, and considering α =5% and β =20%, the sample size calculated based on the formula of comparing two averages is 116 people, 58 people in the intervention group and 58 people in the control group.

$$n = \frac{2(z_{1-\alpha} / 2 + z_{1-\beta})^2 \delta^2}{d^2}$$

The number of dropouts in this study was four people, and finally, 112 people were included in the study.

After receiving the ethics code in research from Sirjan Faculty of Medical Sciences, patients were contacted by phone and if they agreed, their names were registered and it is determined that they refer to the diabetes clinic at a certain time. If a person does not return to complete the questionnaire, she/he will be contacted by phone and asked for the reason, and the person will be asked to specify a time to complete the questionnaire. In case of not agreeing to cooperate, another person with a file in the diabetes clinic will be selected and replaced.

If a person does not return to complete the questionnaire, she will be contacted by phone and asked for the reason, and the person will be asked to specify a time to complete the questionnaire. In case of not agreeing to cooperate, another person with a file in the diabetes clinic will be selected and replaced.

On the appointed day, the researcher introduced herself and stated the purpose of the study. In case of people's desire to participate in the study and also signing a written consent to complete the questionnaire along with compliance with ethical standards the research was begun. Patients were assured that their information would remain confidential.

Data collection tool and technique

To collect data in this study, a questionnaire consisting of two sections was used. The first section was Pender's health promotion model[4] and the second part included six questions related to the consumption of fruits and vegetables based on the BRFSS questionnaire.[14] To measure the perceived benefits construct (7 questions) such as "regular consumption of fruits and vegetables prevents the development of diabetes." and the perceived barriers construct (8 questions) such as "Because vegetables need to be cleaned, I use them less." with a five-point Likert scale (1 = completely disagree to 5 = completely agree) was considered. Self-efficacy construct (include 8 questions) such as "I am confident that I can eat fruits and vegetables even if my family members do not eat them." and feelings related to behavior (include 8 questions) such as "daily consumption of fruits is pleasant for me." was scored by a five-point Likert scale (1 = not at all to 5 = very much). The interpersonal influencers construct consists of two parts (interpersonal norms (7 questions) such as "how much family members expect you to regularly consume fruits and vegetables daily and encourage you to consume them." and interpersonal modeling (7 questions) such as "How do you think fruit and vegetable consumption is in doctors?" was measured by a five-point Likert scale (1 = not at all to 5 = very much). Situational influencers construct (7 questions) such as "Have you ever read anything on the internet about the daily consumption of fruits and vegetables in diabetic patients?" and measurement of commitment to the plan of action (8 questions) such as "I plan to always leave a bowl of fruit available." were measured with options (yes, no). Completing the questionnaire takes about 15 minutes.

Demographic information was also collected at the same time. Also, the selected sample in both control and intervention groups was introduced to the accredited laboratory for glycosylated hemoglobin (HbA1c) test.

After collecting questionnaire data and conducting experiments from both intervention and control groups, WhatsApp virtual groups and educational messages about fruit and vegetable consumption in diabetic patients based on Pender's model were used for interventions for twelve weeks. An educational text based on Pender's model structures including benefits and barriers of fruit and vegetable consumption in diabetic patients, self-efficacy and commitment to action for fruit and vegetable consumption, interpersonal and situational influencers and norms of fruit and vegetable consumption, as well as behavior consumption of fruits and vegetables in diabetic people was posted in the virtual group daily. Educational videos were sent two days a week, and one day a week was dedicated to questions and answers for diabetics.

To ensure that the messages were sent, the researcher activated the "delivered" option on her phone by checking the delivery message by the patients, ensuring that the participants received the message on time and correctly. A number was given to each of the messages; For each message delivered to the patients, a mark was placed in front of the said message. If no more than two messages are sent, the person was contacted and the reason was asked, and if necessary, another cell phone number of the person or one of the people who lives with the diabetic person was obtained and the message was sent to the new number.

In the control group, only routine interventions were performed by the physicians and diabetes clinic personnel. Three months after the end of the interventions, the Pender model questionnaire was completed by patients again and the glycosylated hemoglobin (A1C) (Hb) of the two control and intervention groups was examined. In the end of the intervention, all the diabetics' patients in the control group were added to the educational WhatsApp group and received the educational content.

Quantitative content validity of the Pender Model Questionnaire was done by two methods of Content

Validity Ratio (CVR) and Content Validity Index (CVI). In order to determine CVI and CVR questionnaire was distributed among ten expert professors in the field of questionnaire design. CVR has been approved with a scientific validity of 86% and CVI of all questions above 80%.[4] Also, to determine the reliability of the Pender questionnaire, two methods of Cronbach's alpha coefficient and test-retest and ICC were used. Cronbach's alpha coefficient of each dimension has been confirmed as below: self-efficacy 89%, perceived benefits 92%, perceived barriers 91%, interpersonal norms 85%, interpersonal patterns 84%, emotions related to behavior 94%, and commitment to action plan 80%.[4]

In order to check the quantitative content validity of the Pender model questionnaire, using two methods, CVR and CVI, ten expert professors in questionnaire design examined it and CVR with a scientific validity of 86% and CVI of all the questions was 80%, which have been approved.

Ethical considerations

After receiving the ethics code in the research (grant number: 400000023 and ethics code: IR.SIRUMS.REC.1400.027), organizational coordination, letter of introduction, and explanation about the objectives and method of the research, informed consent was obtained from the eligible participants.

Results

In the present study, 71.6% of the participants were female and the others were male. The mean participant age was 48.5 ± 13.5 years and most of the participants had diploma degrees and less (79.1%) [Table 1].

According to paired *t*-test, in the control and experimental group, there was a significant difference between the mean scores of perceived benefits, perceived barriers, perceived self-efficacy, behavior-related affect, interpersonal and situational influences, commitment to action, and nutritional behaviors before and after the intervention ($P < 0.001$) [Table 2].

The comparison of each of the construction in the control and intervention groups showed that there is a significant difference in the average scores in each group before and after the intervention. Comparing the level of HbA1C in each group showed a significant difference group before and after the intervention.

Comparing the score of the constructs between the control and intervention groups before and after the intervention showed that the perceived benefits and situational effects has a significant difference between the groups before and after the intervention.

Table 1: Provides a basic outline of the participant demographic data

Variable	Total *n* (%)	Control *n* (%)	Intervention *n* (%)	
Gender				
Male	33 (28.4)	13 (22.4)	20 (34.5)	
Female	83 (71.6)	45 (77.6)	38 (65.5)	
Age group				
<50	55 (49.1)	16 (29.6)	39 (67.2)	
50 and more	57 (50.9)	38 (70.4)	19 (32.8)	
Education				
Diploma and less	91 (79.1)	50 (87.7)	41 (70.7)	
University	24 (20.9)	7 (12.3)	17 (29.3)	
Marital status				
Single	9 (7.8)	4 (6.9)	5 (8.6)	
Married	107 (92.2)	54 (93.1)	53 (91.4)	
Income				
Low	39 (33.6)	23 (39.7)	16 (27.6)	
Moderate or good	77 (66.4)	35 (60.3)	42 (72.4)	
History				
Yes	76 (65.5)	38 (65.5)	38 (65.5)	
No	40 (34.5)	20 (34.5)	20 (34.5)	
	Before	After	Before	After
HbA1C	10.4±13.9	10.6±14.1	8.3±2.3	8.0±1.9

The findings showed that before the intervention, 47.4% (36 people) of the participants in the control group and 52.6% (40 people) in the intervention group consumed two or more units of fruit. After the intervention, the amount of consumption reached 49.3% (34 people) and 50.7% (35 people), respectively. Also, comparing the consumption of vegetables showed that before the intervention, 56.4% (31 people) of the participants used two or more units of vegetables and 43.6% (24 people) of the intervention group used two or more units of vegetables. But after the intervention, this percentage and frequency were 49.2% (30 people) in the control group and 50.8% (31 people) in the intervention group.

Comparison of fruit, vegetable, and salad consumption in the intervention and control groups before and after the educational intervention did not show any significant difference between the amount of fruit, vegetable, and salad consumption in each group.

The regression analysis showed that the consumption of salad and vegetables between two groups before and after the intervention is significant [Table 3].

Discussion

This study aimed to determine the effect of Pender's HPM to improve the consumption of fruit and vegetables in diabetic patients. There was no or a poor correlation between consumption behavior and Pender's model constructs such as perceived benefits, perceived barriers, interpersonal factors, and situational factors. By contrast, in studies conducted by O'Neal *et al*. on

Table 2: Comparison of the mean differences of Pender's HPM components before and after intervention in the experimental and control groups

Variable	Group	Mean±SD		*P**
		Before intervention	After intervention	
HbA1C	Control	10.47±13.9	10.61±14.16	0.037
	Intervention	8.36±2.3	8.09±1.91	<0.001
	*P***	0.718	0.092	
	*P****		0.214	
Perceived benefits	Control	27.53±4.07	32.20±3.53	<0.001
	Intervention	27.71±4.03	30.81±3.36	<0.001
	*P***	0.910	0.059	
	*P****		0.267	
Perceived barriers	Control	22.66±6.66	25.76±8.18	0.008
	Intervention	24.07±7.63	26.27±7.46	0.342
	*P***	0.465	0.464	
	*P****		0.602	
Perceived self-efficacy	Control	22.84±7.49	26.93±5.40	0.003
	Intervention	21.71±7.81	28.13±5.30	<0.001
	*P***	0.425	0.270	
	*P****		0.066	
Interpersonal norms	Control	24.90±5.11	29.70±4.44	<0.001
	Intervention	23.86±5.29	30.00±4.48	<0.001
	*P***	0.276	0.652	
	*P****		0.862	
Interpersonal patterns	Control	25.50±3.50	30.59±4.44	<0.001
	Intervention	24.91±4.52	30.00±4.55	<0.001
	*P***	0.436	0.665	
	*P****		0.035	
Situational influencer	Control	10.84±2.21	10.26±2.26	0.098
	Intervention	11.34±2.41	9.69±1.90	0.001
	*P***	0.172	0.210	
	*P****		0.205	
Positive affect	Control	22.52±5.23	25.67±5.13	0.003
	Intervention	25.14±8.72	25.63±3.61	0.282
	*P***	0.064	0.698	
	*P****		0.084	
Negative affect	Control	5.28±2.63	4.17±0.53	0.023
	Intervention	5.34±2.66	4.48±1.51	0.024
	*P***	0.828	0.617	
	*P****		0.167	
Commitment to action	Control	2.86±2.60	4.09±2.59	0.033
	Intervention	2.60±2.54	4.79±2.64	<0.001
	*P***	0.635	0.181	
	*P****		0.395	

*P**: Paired *t*-test or Wilcoxon signed-rank test; *P*** : Two Independent Samples *t*-test or Mann–Whitney *U* test; *P**** : ANCOVA. Kolmogorov–Smirnov test was used to check the normality of numerical variables in different subgroups. Based on the results obtained from this test, in the case of normality, parametric *t*-tests of two independent samples or paired *t*-tests were used. In the case of non-normality, Mann–Whitney–Yu or Wilcoxon non-parametric equations were used

African-American adults and Solhi *et al*. on female students living in dormitories, it was shown that social support and perceived benefits play a major role in the consumption of fruits and vegetables.[15,16] These results are not consistent with the findings of the present study. This contradiction is due to the fact that we could not hold training sessions for the participants in person and the training was limited to sending educational messages to the patients through the WhatsApp group. Another reason for this inconsistency between the present study and previous studies was due to the rapid change in economic conditions in Iran, which affected the purchasing power of the people. Also, the study results demonstrated that female participants, on average, consumed more F every day. This is consistent with the findings of Zamanian *et al*. in 2013 in Arak.[17] Considering the role of women in choosing the food basket of households, future studies can use women as the main intervention group to influence other groups in relation to adopting proper nutritional behaviors.

Table 3: Comparing fruits and vegetables consumption between control and intervention groups after intervention

	Perceived benefits		Interpersonal patterns	
	Before	After	Before	After
Fruits				
B	0.70	0.84	0.04	o. 34
P	0.36	0.27	0.95	0.73
Juice				
B	0.51	0.32	1.74	1.01
P	0.54	0.65	0.03	0.24
Vegetables				
B	1.72	2.17	0.40	1.96
P	0.02	0.00	0.59	0.03
Salad				
B	1.90	1.60	0.31	2.35
P	0.01	0.03	0.67	0.01

In the present study, the results showed that there was a significant relationship between the constructs of perceived benefits and interpersonal influencers with vegetable and salad consumption. But there was no relationship between perceived benefits and interpersonal influencers with fruit and juice consumption.

In this study, the interpersonal influences construct was effective on vegetable and salad consumption in diabetic patients was effective, which was not consistent with the findings of fruit and vegetable consumption in diabetic patients in Mohammadi Zeidi *et al*.[18]

There was a significant relationship between the benefits construct and the consumption of vegetables and salads in diabetic patients after the intervention. In studies examining the effect of educational programs on diabetic patients, there was a relationship between the perceived obstacles structure in the intervention group.[19,20]

But in another study about fruit and vegetable consumption in diabetic patients which had been conducted based on Pender's model, there was no significant relationship between the structure of perceived benefits and fruit and vegetable consumption.[4]

A study that investigate the effect of an educational intervention based on Pender's HPM on the lifestyle of patients with type 2 diabetes, showed that interpersonal and situational influencing structures were not effective on fruit and vegetable consumption in diabetic patients.[5]

Surveys show that in most studies, self-efficacy constructs and barriers are perceived as effective and involved factors in performing behaviors. In the studies of Lubans and Rasmussen, self-efficacy has been reported as the most important determinant of nutritional behaviors, including fruit and vegetable consumption.[21,22]

But in our study, there was no relationship between fruit and vegetable consumption with perceived self-efficacy constructs and perceived barriers. The finding of a study that investigated the factors affecting the consumption of fruits and vegetables in diabetic patients based on Pender's HPM, indicated that the consumption of vegetables in diabetic patients is less than the consumption of fruits.[4] In another study, the average consumption of fruits and vegetables in diabetic patients was almost the same and even the consumption of vegetables was slightly higher.[23] Probably, the lower consumption of fruit and natural juice in this study is related to the demographic variables of the participants and the nutritional culture of the people in the study region. Also, it seems that obstacles such as price, lack of access, time-consuming, and not having enough time are important for the consumption of fruits and vegetables among the participants of this study. Therefore, planning to reduce perceived barriers can have a positive effect on increasing fruit and vegetable consumption in diabetic patients. Wang *et al*., in their study, investigated if higher intake of fruits, vegetables, or fiber reduces the risk of type 2 diabetes. The findings of their study showed that increasing fruit consumption, especially berries, has an inverse relationship with the risk of type 2 diabetes. Also, increasing the consumption of vegetables, especially green and yellow leafy vegetables, can help reduce the risk of diabetes.[24]

The results of the present study in the group of diabetic patients showed that the possibility of interpersonal influences is an indicator of the effect of emphasizing and encouraging important people such as physicians and health care staff to consume fruits and vegetables in diabetic participants.

Limitation and recommendation

One of the strengths of this study was the use of a comprehensive model to explain and estimate fruit and vegetable consumption in diabetic patient. Another strength of the study was the investigation of the effect of the fruit juice and salad consumption training program in this study, which in most studies only fruit and vegetable consumption was examined. The small size of the research sample was one of the limitations of the research, since the sampling was only from the specialized diabetes clinic, which lowers the generalizability of the study. Another limitation of this research was the self-reported nature of data collection. One of the most important limitations of this study was the Covid-19 pandemic, which did not allow us to meet in person due to the sensitivity of the underlying disease in this group, and we had to send our messages to these people virtually. It is suggested that more studies should be conducted using this comprehensive model of Pander's educational intervention program in diabetic

patients and in the conditions, where people have the possibility of face-to-face training.

Conclusion

The findings of this study provide useful information for health professionals and health planners to gain a more accurate understanding of the factors affecting fruit and vegetable consumption in diabetic patients. Considering that the perceived benefits and interpersonal and situational influencers are effective on the consumption of fruits and vegetables in diabetic people; therefore, it is very important that health planners design educational interventions in order to increase the consumption of fruits and vegetables in the target group by considering these effective determinants.

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Conflicts of interest

There are no conflicts of interest.

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