Original Article

The Effects of a Training Program Based on the Health Promotion Model on Physical Activity in Women with Type 2 Diabetes: A Randomized Controlled Clinical Trial

Soghra Rouholamini[1], Mahin Gheibizadeh[2], Elham Maraghi[3], Alireza Jahanshahi[4]

[1]Department of Nursing, School of Nursing and Midwifery, Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran, [2]Nursing Care Research Center in Chronic Diseases, Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran, [3]Department of Biostatistics and Epidemiology, School of Health, Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran, [4]Department of Internal Medicine, School of Medicine, Golestan Hospital, Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran

Abstract

Background: Physical activity among women with type 2 Diabetes Mellitus (DM) is an undesirable level. This study aimed to determine the effect of a training program based on the Health Promotion Model (HPM) on physical activity in women with type 2 DM. **Materials and Methods:** This randomized clinical trial was performed on 128 women with type 2 DM, who were randomly assigned to control and intervention groups. Data were collected using the Baecke Physical Activity Questionnaire (BPAQ) and a researcher-made questionnaire designed based on the HPM constructs before and 2 months after the intervention. The training was carried out in four sessions in the intervention group and the control group received regular education at the clinic. Data were analyzed using Chi-square, Fisher's exact test, paired *t*-test, independent *t*-test, and Mann–Whitney and Wilcoxon tests in Statistical Package for the Social Sciences (SPSS) software. **Results:** The findings showed that the mean [Standard Deviation (SD)] of physical activity in the intervention and control groups before the intervention was 6.52 (0.86) and 6.56 (1.07), respectively, and there was no significant difference between the groups ($p = 0.95$). However, after the intervention, the mean (SD) of physical activity in the intervention and control groups was 8.04 (0.92) and 6.33 (1.60), respectively, which showed a significant difference ($t_{126} = 9.71$, $p < 0.001$). **Conclusions:** The findings of this study revealed that the training program based on the HPM has a positive effect on improving physical activity in women with type 2 DM.

Keywords: *Diabetes mellitus, education, exercise, health promotion, nursing, women*

Introduction

Diabetes Mellitus (DM), a prevalent metabolic disease in the world, contributes to about 9% of all deaths worldwide.[1,2] The International Diabetes Federation (IDF) has reported an increase in the prevalence of DM worldwide, and that by the year 2045, 700 million people in the world will develop DM.[3] According to Guariguata *et al*. report in 2014, it is estimated that the prevalence of type 2 diabetes in Iran will increase to 12.3% in 2035.[4]

One fundamental pillar of the treatment and management of DM is physical activity.[5] Much evidence suggests that physical activity has a therapeutic effect in the prevention and management of type 2 DM, and is associated with a 60% reduction in the risk of developing DM in people with impaired glucose tolerance.[6,7] However, according to the World Health Organization (WHO), inactivity is the fourth leading cause of death globally and accounts for approximately two million deaths annually.[8,9] The problem of inactivity is more prevalent in women than in men. According to the British Women's Sport and Fitness Federation (WSFF), only one-fifth of women are taking part in sports for their health, and, physical activity is of low priority among women.[10] It is estimated that 90% of Iranian women with DM do not have adequate mobility and physical activity.[11]

Upgrading and maintaining physical activity is a complex behavior that is not easy to change, and even if one succeeds in changing it, it is difficult to maintain the new behavior. Health models provide a useful framework for improving health behaviors such as physical activity.[12] Pender's Health Promotion Model (HPM), by providing an appropriate framework,

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Address for correspondence:
Dr. Mahin Gheibizadeh, Nursing Care Research Center in Chronic Diseases, Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran. E-mail: gheibizadeh-m@ajums.ac.ir; mgheibizadeh@yahoo.com

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serves as a guide for researchers and health professionals to intervene effectively.[13,14] According to the Pender's HPM, each person has a multidimensional totality interacting with interpersonal and physical environments and plays an active role in achieving improved health status.[15-17] The HPM focuses on three domains of personal experiences and characteristics, specific feelings and cognitions of behavior, and behavioral outcomes.[18]

The effectiveness of interventions based on the HPM on promoting healthy behaviors has been investigated in several studies.[19-21] Although related studies in diabetic women are limited, they emphasized the importance of using models in predicting physical activity.[21,22] Nurses can provide their patients with advice regarding health-promoting behaviors such as physical activity using HPM. As they are in close relationships with their patients and are aware of their problems, they are considered the most suitable for patient education.[23-25] Considering the necessity of promoting physical activity in diabetic women and the role of HPM constructs in predicting health-promoting behaviors, the researchers decided to conduct a study with the aim to determine the effect of a training program based on HPM on physical activity in women with type 2 DM.

Materials and Methods

This randomized clinical trial (IRCT20180514039655N1) was conducted with a pretest-posttest design on 128 women with type 2 DM referring to Imam Khomeini and Golestan hospitals in Ahvaz, Iran, from May to August 2018. The sample size was calculated as 128 individuals using the sample size formula and considering 10% attrition and $\alpha = 0.05$, $\beta = 0.90$, $d = 200$, and $s = 331.10$ in reference to previous studies.[26]

The inclusion criteria included individuals aged 30 to 60 years, the ability to participate in training sessions, the ability to read and write, resident of Ahvaz city, lack of a physical activity restriction, lack of pregnancy, and at least 1 year since diagnosis of DM. The exclusion criteria were absence from more than one training session, becoming pregnant during the study, and medical prohibition for physical activity during the intervention. One hundred and twenty-eight eligible women were randomly assigned to control ($n = 64$) and intervention ($n = 64$) groups using a block permutation method with block size 4 (using table of random permutations). The random assignment was made by a statistical consultant who was a member of the research team [Figure 1].

After the random assignment of the participants to groups, the pre-test was conducted in both groups. The training program was designed based on the HPM and according to the results of the pretest. After approval of the designed educational content by three nursing faculty members and two endocrinologists, it was implemented in the intervention group. The control group received routine clinical training. The intervention group received four training sessions of 60-90 minutes (two sessions a week) using the lecture and question and answer methods. Moreover, educational films, pamphlets, and daily incentive messages were provided for them [Table 1]. A post-test was conducted for both groups 2 months after the intervention. For ethical consideration, the training package was provided to the control group after the post-test.

The data collection tools were a demographic information questionnaire, the Baecke Physical Activity Questionnaire (BPAQ), and a researcher-made questionnaire of HPM constructs. The BPAQ was designed in 1982,[27] and includes 16 questions in three dimensions of physical activity related to the occupation (questions 1 to 8), sports activity (questions 9 to 12), and physical activity during leisure time (questions 13 to 16). Each item is scored on a 5-point scale ranging from 1 to 5. The mean scores of each subscale are calculated. Then, the overall score of physical activity is derived from the sum of the mean scores in the 3 subscales. Thus, the total physical activity score is from 3 to 15. Higher scores represent more physical activity. Sanaee *et al*. reported the reliability of the Persian version of the questionnaire at 0.78, which confirms the internal consistency of the questions.[28]

The HPM questionnaire designed by the research team included 69 questions in 9 subscales of perceived feelings related to behavior (8 questions), perceived benefits (13 questions), perceived barriers (10 questions), perceived self-efficacy (10 questions), interpersonal influences (6 questions), situational influences (4 questions), immediate demands and preferences (5 questions), commitment to action (8 questions), and previous related behaviors (5 questions). The questions were scored a 5-point Likert scale ranging from 1 to 5.

To determine the content validity of the researcher-made questionnaire, it was sent to 10 faculty members of Ahvaz Jundishapur University of Medical Sciences, Iran to evaluate the proportion of the designed items. Based on their views and the Content Validity Index (CVI) and Content Validity Ratio (CVR), the necessary changes were made to the tool and the final version of the questionnaire was developed. The original version of the questionnaire included 74 questions. After determining CVI and CVR, five questions were removed and the final version was adjusted with 69 questions. Using Cronbach's alpha coefficient, the reliability of this tool was calculated at 0.85, which indicates the desirable reliability of the questionnaire. Data collected in the pre-test and post-test were analyzed using Chi-square test, Fisher's exact test, paired *t*-test, independent *t*-test, and Mann–Whitney and Wilcoxon tests in Statistical Package for the Social Sciences (SPSS) software (version 16, SPSS Inc., Chicago, IL, USA).

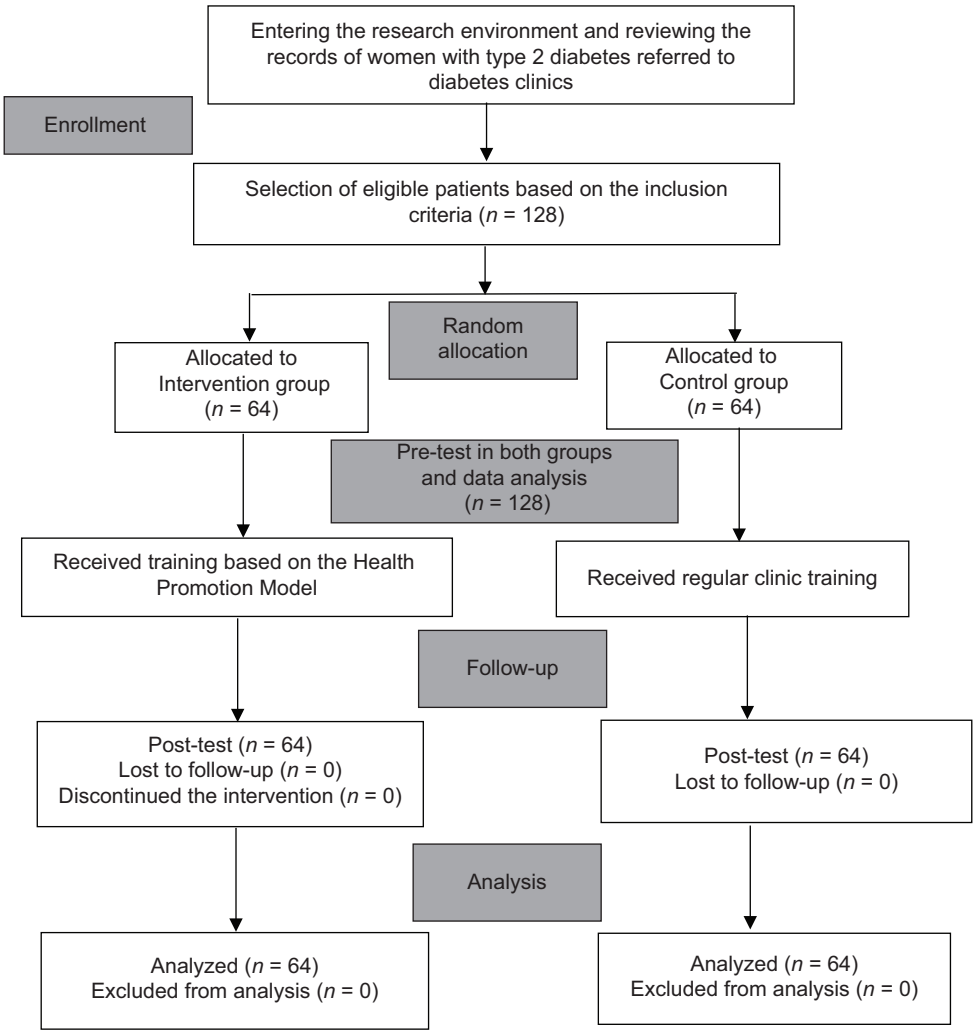

Figure 1: CONSORT flow chart

Ethical considerations

This study was approved by the Research Ethics Committee of Ahvaz Jundishapur University of Medical Sciences (IR.AJUMS.REC.1397.108). Ethical considerations including confidentiality of participants' information, informed consent of the participants, explanation of the research goals, voluntary participation in the research, permission to leave the study at any time, and trusteeship in using literature were taken into consideration.

Results

In the present study, 128 diabetic women participated. The participants' mean [Standard Deviation (SD)] age was 47.59 (8.37) and 49.83 (8.69) years in the control and intervention groups (p = 0.11), respectively. The mean (SD) of Body Mass Index (BMI) was 26.84 (5.07) and 28.69 (5.78) in the control and intervention groups (p = 0.05), respectively. Most of the participants had a high school diploma (85.90%), were housewives (95.31%), and married (92.20%). There was no statistically significant difference between the two groups in terms of demographic information [Table 2].

The results showed that there was no difference between the mean scores of physical activity between the two groups before the intervention (p = 0.95), but showed a significant difference between them after 2 months of intervention (t_{126} = 9.71, p < 0.001). In terms of physical activity subscales, there were significant differences between the two groups after the intervention [Table 3]. Data analysis using paired t-test showed significant differences in scores of physical activity and its subscales in the intervention group, while there were no significant changes except in the sports activity subscale in the control group [Table 3].

According to the findings of the study, no significant differences were found between the two groups in terms of HPM constructs before the intervention. However, 2 months after the intervention, in all model constructs, except for the previous related behavior construct (p = 0.84), statistically significant differences were found between the two groups [Table 4].

Table 1: The content of the training sessions in the intervention group

Session	List of activities	Related construct in the HPM*
1	Brief introduction to the research aims	Feelings related to the activity
	Highlighting the complications of DM** by presenting its prevalence in women	Perceived sensitivity
	The need for physical activity for patients with DM	
	Optimal physical activity for patients with DM	
	A set of pre-activity measures in patients with DM	
	Talking about creating groups in cyberspace to send persuasive messages	
	Providing educational pamphlets to double the motivation for physical activity	
2	Emphasizing the benefits and importance of physical activity	Perceived benefits
	The importance of early or late physical activity	Perceived barriers
	Group discussion on barriers to physical activity	
	Describing potential barriers to physical activity	
	How to overcome perceived obstacles	
	Using the problem-solving process to remove barriers to physical activity	
	Distributing educational pamphlets on the benefits and obstacles of physical activity	
3	Discussion about commitment to physical activity	Commitment to the plan
	Making use of verbal incentives and providing direct and indirect experiences	Perceived self-efficacy
	Distributing educational pamphlets to build commitment and provide successful experiences following physical activity	
	Emphasizing on the presence of an important and influential person for each patient in the fourth session	
4	Emphasis on physical activity	Interpersonal influences
	Emphasis on walking instead of personal and public vehicles	Situational influences
	Encouraging personal daily activities to enhance physical activity	Competitive immediate preferences and desires
	Encouraging companions to engage with patients and encourage them to take part in a physical activity promotion program	
	Discussion about identifying available resources, requirements, and environmental characteristics that influence physical activity	
	Distributing educational pamphlets to engage family, friends, and influential persons and overcome situational factors	

*Health Promotion Model, **Diabetes Mellitus

Discussion

In the present study, applying a training program based on HPM empowered diabetic women in terms of physical activity performance. However, in the control group, not only an increase in the physical activity score was observed but also a significant decrease in the physical activity score over time was observed. These findings indicate the effectiveness of the educational program designed based on HPM in increasing the level of physical activity Heidari *et al*.[29] and Taymoori *et al*.[30] reported that after applying model-based training, physical activity level was significantly increased in the intervention groups, which was consistent with our findings. In fact, models reinforce behavior change and healthy behaviors by targeting important and influential elements of behavior.

Findings showed that perceived benefits of physical activity increased after the intervention in the intervention group, which means that education based on HPM has been able to make patients' viewpoints about the benefits of physical activity more positive. Zamani *et al*.[31] and Rahimian *et al*.[26] in their studies also reported similar results regarding the positive impact of model-based education on improving the attitudes of the study population toward expected behaviors.

In this study, the perceived barriers to physical activity decreased significantly after the intervention. In other words, after the intervention, they believed that there were fewer obstacles in their path to physical activity. This may have contributed to the increase in physical activity in the women in the intervention group after the intervention. Amanda *et al*., in their study, reported that perceived barriers are an important factor in the adherence of women with DM to healthy lifestyle behaviors.[32]

In this study, self-efficacy, commitment to action, improved interpersonal and situational influences, and immediate demands and preferences decreased in the intervention group compared to the control group after the intervention. In a study conducted by Kurnia *et al*., situational influences,

Table 2: Frequency and percentage distribution of the demographic and clinical variables between the control and intervention groups

Variable		Groups		χ^2	df	*p**
		Control (*n*=64) *n* (%)	Intervention (*n*=64) *n* (%)			
Ethnicity	Arab	27 (42.20)	39 (60.90)	4.50	1	0.34
	Bakhtiari	37 (57.80)	25 (39.10)			
Level of education	Diploma	15 (23.40)	9 (14.10)	1.85	1	0.17
	Pre-diploma	49 (76.60)	55 (85.90)			
Job	Housewife	60 (93.75)	61 (95.31)	0.89	1	0.99
	Employed	4 (6.25)	3 (4.68)			
Income	>5.000.000 Iranian Rial	60 (93.75)	61 (95.30)	4.01	3	0.26
	5.000.000-10.000.000 Iranian Rial	3 (4.69)	1 (1.60)			
	10.000.000-20.000.000 Iranian Rial	0 (0)	2 (3.10)			
	<20.000.000 Iranian Rial	1 (1.56)	0 (0)			
Marital status	Married	58 (90.60)	59 (92.20)	0.99	1	0.75
	Single	6 (9.40)	5 (7.80)			
Therapeutic center	Emam Hospital	32 (50)	33 (51.60)	0.03	1	0.86
	Golestan Hospital	32 (50)	31 (48.40)			
Duration of medication (year)	1-5	30 (46.90)	21 (32.80)	5.16	2	0.07
	6-10	29 (45.30)	30 (46.90)			
	11-15	5 (7.80)	13 (20.30)			
Sport history	Yes	15 (76.60)	16 (25)	0.04	1	0.83
	No	49 (23.40)	48 (75)			
Family history of diabetes	Yes	60 (93.80)	62 (96.90)	0.69	1	0.40
	No	4 (6.30)	2 (3.10)			
Duration of morbidity (year)	1-5	28 (43.80)	20 (31.30)	3.96	2	0.13
	6-10	25 (39.10)	24 (37.50)			
	< 10	11 (17.20)	20 (31.30)			

* Chi-squared or Fisher's exact tests

Table 3: Comparison of mean (standard deviation) of physical activity and its domains between the control and intervention groups before and after the intervention

Variable		Groups		*t*	df	*p**
		Intervention (*n*=64) Mean (SD)	Control (*n*=64) Mean (SD)			
Total physical activity	Before the intervention	6.52 (0.86)	6.56 (0.07)	-0.19	126	0.95
	Two months after the intervention	8.04 (0.92)	6.33 (1.06)	9.71	126	<0.001
	t	-16.26	3.99			
	df	63	63			
	*p***	<0.001	<0.001			
Physical activity related to occupation	Before the intervention	2.60 (0.36)	2.61 (0.44)	-0.16	126	0.87
	Two months after the intervention	2.85 (0.36)	2.62 (0.44)	3.23	126	0.001
	t	-17.31	-1.00			
	df	63	63			
	*p***	<0.001	0.32			
Sports activity	Before the intervention	2.13 (0.48)	2.17 (0.50)	-0.46	126	0.75
	Two months after the intervention	2.37 (0.47)	1.90 (0.43)	5.82	126	<0.001
	t	-4.47	9.56			
	df	63	63			
	*p***	<0.001	<0.001			
Physical activity during leisure time	Before the intervention	1.78 (0.48)	2.82 (0.50)	0.21	126	0.61
	Two months after the intervention	2.82 (0.50)	1.81 (0.62)	10.08	126	<0.001
	t	-19.98	-1.42			
	df	63	63			
	*p***	<0.001	0.16			

*Independent *t*-test. **Paired *t*-test

Table 4: Comparison of mean (standard deviation) of the Health Promotion Model constructs between the control and intervention groups

Variable		Groups		*z*	*p**
		Intervention (*n*=64) Mean (SD)	Control (*n*=64) Mean (SD)		
Feelings related to behavior	Before the intervention	31.56 (4.20)	31.71 (4.02)	-0.27	0.78
	Two months after the intervention	35.89 (1.79)	31.73 (4.03)	-7.33	<0.001
	z	-5.97	-0.44		
	*p***	<0.001	0.65		
Perceived benefits	Before the intervention	52.39 (6.42)	52.17 (8.88)	-0.36	0.71
	Two months after the intervention	64.89 (0.64)	52.18 (8.87)	-10.01	<0.001
	z	-6.79	-1.00		
	*p***	<0.001	0.31		
Perceived barriers	Before the intervention	25.87 (12.40)	27.23 (88.11)	-0.75	0.44
	Two months after the intervention	48.59 (3.10)	27.26 (11.67)	-9.27	<0.001
	z	-6.61	-1.00		
	*p***	<0.001	0.31		
Self-efficacy	Before the intervention	14.01 (4.93)	67.13 (5.01)	-0.86	0.38
	Two months after the intervention	49.40 (3.01)	15.17 (7.68)	-10.14	<0.001
	z	-6.93	-1.82		
	*p***	<0.001	0.06		
Interpersonal influences	Before the intervention	24.40 (4.77)	24.32 (4.80)	-0.39	0.69
	Two months after the intervention	29.87 (0.48)	24.37 (4.13)	-9.34	<0.001
	z	-6.16	-1.00		
	*p***	<0.001	0.31		
Situational influences	Before the intervention	14.37 (2.12)	13.96 (2.46)	-1.16	0.39
	Two months after the intervention	16.20 (0.81)	13.90 (2.33)	-6.60	<0.001
	z	-5.10	-1.00		
	*p***	<0.001	0.31		
Immediate demands and preferences	Before the intervention	8.45 (2.40)	13.84 (3.83)	-1.78	0.07
	Two months after the intervention	8.45 (2.40)	16.15 (3.83)	-9.12	<0.001
	z	-6.85	-1.06		
	*p***	<0.001	0.28		
Commitment to action	Before the intervention	11.03 (2.80)	10.75 (3.38)	-0.90	0.36
	Two months after the intervention	39.54 (2.40)	11.34 (5.04)	-10.04	<0.001
	z	-6.92	-1.34		
	*p***	<0.001	0.18		
Previous related behaviors	Before the intervention	11.51 (3.66)	11.39 (3.48)	-0.05	0.95
	Two months after the intervention	11.59 (2.40)	11.59 (3.48)	-0.19	0.84
	z	-1.63	0.00		
	*p***	0.10	0.99		

*Mann-Whitney test **Wilcoxon Signed Ranks test

social support, self-efficacy, and perceived benefits showed significant correlations with self-management of DM and self-efficacy was reported as an effective factor of DM self-management.[33] Taymoori *et al*. also stated that educational intervention based on HPM had a significant effect on decreasing immediate demands and preferences.[30] Interpersonal influence such as family has a major impact on the process of social education, sports activities,[34] and other behavioral tendencies; the level of family support for sports activities, family attitudes toward exercise, and the rate of acceptance of exercise among family members directly affect society as a whole.[35] In the study by Khalkhali *et al*., which was conducted to investigate the effect of family education on self-care in patients with type 2 DM, it was found that interpersonal influences, in particular the family, have the most impact on self-care and its dimensions in patients with DM.[36]

This study, like other studies, has limitations that need to be considered. One of the limitations of the study was the use of a self-report method for measuring physical activity in the participants, which is affected by the level of honesty of the participants in reporting physical activity. Another limitation was the short duration of follow-up (2 months), which makes it impossible to evaluate the effectiveness of the intervention in sustaining behavior over time.

Therefore, further studies using more precise methods to measure physical activity and a longer follow-up period are recommended.

Conclusion

Considering the effective role of the educational program based on the HPM in improving the level of physical activity of women with DM, it is recommended that more extensive educational interventions be designed and implemented to encourage patients to carry out physical activity to address the complications associated with DM through cost-effective and less complicated methods.

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Conflicts of interest

Nothing to declare.

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