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The Impact of a Theory-Based Education on Physical Activity among 'Health Volunteers': A Randomized Controlled Trial

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ABSTRACT

Aims Physical inactivity and a sedentary lifestyle increase the risk of all-cause mortality. This study aimed to assess the impact of a theory-based education on PA among female health volunteers in Iran by applying the Theory of Planned Behavior.

Materials & Methods This randomized controlled trial was conducted on female health volunteers in Shushtar, Iran, from March to December 2016. One hundred ten participants were selected by purposive sampling, and they were randomized into intervention and control groups based on a 1:1 ratio in a single block. The intervention included three educational sessions and a walking program. A multi-section questionnaire containing items on TPB constructs, the international physical activity questionnaire, and the physiological cost index (PCI- an objective measure of PA) was used to collect the data at baseline and six-month follow-up assessments. Then the data were compared within and between groups using t-test and paired test using SPSS 19 software.

Findings All 110 'Health Volunteers' (55 in each group) were entered into the study. The mean±SD age of participants was 35.65±10.25 years. The results obtained from the analysis showed that the educational program improved attitude towards PA, perceived behavioral control, intention, behavior, and PCI among the intervention group ($p<0.001$). However, no significant changes occurred in the control group regarding the study variables ($p>0.05$).

Conclusion The TPB-directed educational program improved physical activity and physiological cost index. The study framework might be used as a practical template for interventions aimed at improving physical activity among female health volunteers.

Keywords Theory of Planned Behavior; Physical Activity; Physiological Cost Index; Women

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Introduction

Inactivity in general and inadequate physical activity (PA) particularly are among the consequences of the modern lifestyle and can increase the risk of all causes of mortality [1]. As recommended by the World Health Organization (WHO), the amount of PA required for individuals aged 18-65 is at least 150 minutes of moderate PA per week, 75 minutes of vigorous PA per week, or even a balanced mix of these activities [2]. However, in general, one out of every three adults worldwide is not active enough [3], and such inactivity is higher among females than males [4]. It is reported that inactivity among women might lead to several health problems, including obesity, diabetes, cardiovascular disease, and depression [5]. Almost 50% of women in the Eastern Mediterranean Region are not active enough [4]. In Iran, Only 18.2% of women exercise at least 10 minutes a day, a value equal to 41.7% among men [6]. Scientific reports stated that physical inactivity causes more than 1.2 million deaths globally and 18,000 deaths in Iran in 2017 [7].

Several factors contribute to physical inactivity. Therefore, it is necessary to implement effective interventions in order to increase PA in women. To provide stability and continuity of behavior, there is a need for theory-based effective behavioral interventions [8]. The theory of planned behavior (TPB) has been used to explain the beliefs, attitudes, subjective norms, perceived behavioral control, and intention and behavior of individuals regarding PA [9]. A meta-analysis showed an effect size of 0.5 for changing PA by applying TPB interventions. This study adds that using TPB for education yielded a mixture of results, affecting all constructs and the others not. It seems there is still room for conducting TPB-based education to understand better the phenomenon of TPB-based education for improving PA among populations [10].

Compared to men, women are less active and needed to promote PA [7]. Women play a key role in family management, hence the effect of their mortality, disability, and behavior on different dimensions of behavioral health and the culture of other family members [11]. This issue raises the importance of attention to health and health-related behaviors such as PA among women, who also play an important role in shaping an active lifestyle within family and society [12]. Health volunteers have humanistic cooperation with healthcare centers to prevent diseases and maintain and promote health among neighbors under Iran's coverage of healthcare services. The most important tasks of healthy volunteers are to teach health-related issues to families and create a connection between healthcare centers and the public [13]. This issue further underscores the importance of education in this target population, especially in countries with a crisis of human resources for health [14].

No TPB-based educational intervention has been implemented to promote PA in health volunteers. Hence, this study aimed to assess the impact of a theory-based education on PA among female health volunteers in Iran through manipulating TPB constructs.

Materials and Methods

This randomized controlled trial was conducted on female health volunteers in Shushtar, Iran, from March to December 2016. One hundred ten participants were selected by purposive sampling, and they were randomized into intervention and control groups based on a 1:1 ratio in a single block. The sample size was estimated by a statistical power analysis. The study's primary outcome was to measure score changes for attitude towards physical activity as the most important determinant of PA. Thus, to detect a 1.6 point increase in the baseline attitude towards physical activity at 5% significance, the study would require a sample of 50 females per study group; considering a 10% dropout in the study samples, each study group would have 55 participants. A 90% power was considered for the study. At first, a list of health volunteers affiliated with Shushtar Health Care Health System was provided. Randomization was achieved using sealed, opaque, sequentially numbered envelopes developed from a random number generator. A research assistant not involved in the recruitment of participants developed the envelopes. This procedure was continued to reach the required number of participants. The study participants were randomized into two groups of intervention and control (55 individuals per group). The intervention was conducted in the Hall of Shushtar Health System. A health care provider blinded to the group's assignment assessed both groups in terms of demographic variables, constructs of TPB, amount of PA, and PCI at baseline. Because of the nature of the intervention in the current study, unlike the participants and statistical investigator, the instructor was not blinded to the group assignment. The inclusion criteria were a minimum one-year experience of cooperation with healthcare centers, no problems in participation in educational classes, consent to participate in the research study, and ability to read and write. The exclusion criteria comprised unwillingness to continue participating, contraindication to PA, and migration to other cities during the study period.

The following questionnaires were used:

1. TPB constructs questionnaire was used as a valid and reliable TPB-based questionnaire developed by Gholamnia *et al*. to assess the behavioral determinants of PA [15]. All the items were answered on a five-point Likert-type scale (scores range from 1 to 5). This questionnaire is comprised of attitude towards behavior (6 items; score range from 6 to 30;

a higher score indicated the better situation) The internal consistency was acceptable as α=0.83; subjective norms (3 items; score range from 3 to 15; a higher score indicated the better situation) The internal consistency was acceptable as α=0.83; perceived behavioral control; (3 items; score range from 3 to 15; a higher score indicated the better situation) The internal consistency was acceptable as α=0.78; intention (3 items; score range from 3 to 15; a higher score indicated the better situation) The internal consistency was acceptable as α=0.79. The questionnaire was distributed among a sample of 30 individuals of the target group that was not from the study participants. The mean of the Cronbach's alpha coefficient for the constructs was equal to 0.88. The stability was evaluated through the test-retest method with an interval of two weeks, and the scores were compared using the Intra-class Correlation Coefficient (ICC). ICC of more than 0.61 was considered satisfactory. The mean ICC for the constructs of the questionnaire was equal to 0.73. It should be mentioned that the reliability and validity of the TBP scale have been reported satisfactory earlier [15].

2. Physical Activity Readiness Questionnaire (PARQ) determines the medical condition and readiness before starting a PA program and specifies if further evaluations are required [16].

Everyone who planned to engage in a "fitness assessment or become "much more physically active" should complete the PARQ. If a participant's answer to PARQ was positive, then s/he is subjected to be visited by a physician for the type and level of physical activity. This questionnaire acts as a screening tool for PA contraindication. The Persian version of this questionnaire is available [17], whose validity and reliability have been confirmed [18].

3. International Physical Activity Questionnaire (IPAQ): According to the questionnaire instructions, the intensity of total PA of each person based on the amount of energy consumed over the past seven days is placed in one of the three groups of Light, Moderate, and High. The activities lasting lower than 10 minutes are excluded from this calculation [19]. Walking, moderate, and high PA account for 3.3, 4, and 8 metabolic equivalents (MET), respectively. It is to be noted that a MET represents the amount of energy used per minute by an individual at rest [20]. To calculate the total amount of PA per week, the amount of walking (MET×minute×day), moderate (MET×minute×day), and vigorous PA by an individual (MET×minute×day) over the last week are brought together [19]. The given questionnaire is also suitable for determining PA among adults aged 15-69 years. It has also been used in numerous studies, and its validity and reliability have been confirmed [21]. This scale was earlier translated to Persian [22].

4. Physiological cost index has been suggested to measure the cost of energy consumed during walking and refers to the difference between heart rate during resting and walking divided by the average speed of walking [23]. Among the notable advantages of this index in science and health centers are its easy use and no need for sophisticated equipment. Also, the integration of heart rate variability and physical activity (average walking speed) is a reliable indicator of the study of physiological energy used during activities by an examined individual [23]. To calculate the PCI, the health volunteers' heart rates were measured telemetrically by Polar Heart Rate Monitor (made in Finland, the RC3 GPS model) in the healthcare center and was recorded in the relevant form. The individuals in the target group became familiar with this device in one session. Further considerations were the required standards for implementing the given test, meaning the health volunteer remained seated on a standard chair for 5 minutes (rest period). The health volunteers were asked not to think of any exciting incidences during testing if their heart rate was influenced. At the end of the five-minute rest period, the study participant started walking around the gym on an oval-shaped walk-path as long as 100 meters (walk period). Following the cessation of the walk period, the individuals rested on a chair for five minutes. In total, three rest periods and three walk periods were followed continuously. The telemetric measurements of heart rates were taken in the recorder during rest and walk periods. The Polar software and site telemetry warrant the unloading of data from recorder to computer for further analysis.

Informed consent was obtained from all participants, and the study was approved by the ethics committee of Ahvaz Jundishapur University of Medical Sciences. The educational intervention was designed following the pretest results of the TPB-based questionnaire. Three educational sessions were held during two consecutive weeks. In the first session (week), a 45-minute lecture was presented using slides and a video projector on the importance of PA and its positive effects on physical, mental, and social aspects. The purpose of this session was to raise awareness among health volunteers, engage their attention, and prepare them emotionally in terms of PA. The second session (week) lasted 60 minutes to influence the constructs of attitude, subjective norm, perceived behavioral control, and behavioral intention through lecture method, Question-and-Answer method, and group discussion. In order to establish the desired attitudes, overcome the negative ones, and reinforce positive attitudes towards PA, the required information was presented on the beneficial effects of physical activities on people's health, the positive impact on changing risk factors, reducing the risk of illnesses and also increased quality of life.

Regarding the influence of subjective norms on PA, the views of specialists were emphasized. An

educational pamphlet was further distributed among health volunteers for their family members. To add to the perceived behavioral control, the study participants were asked to speak about the amount of their control on physical activity behavior and similarly discussed were the easiness and manageability of behavior, planning for time and place, incentives and disincentives of PA, and how to overcome barriers to behavior. The third session was also held to influence the perceived behavioral control intention for 60 minutes. Since individuals make efforts for controllable and applicable behaviors, discussions were focused on the factors facilitating behavior, providing incentives, and reducing barriers to influence the construction of the perceived behavioral control.

Moreover, breaking behaviors into small steps along with encouragements were among other employed strategies. The given program was designed to gradually lead an individual to do 150 minutes of moderate-intensity PA per week for six months. At 6-months follow-up, participants were contacted to complete the questionnaires.

The obtained data were analyzed by the SPSS 19 software (SPSS Inc., USA) at a significant level of 0.05. The Kolmogorov-Smirnov test was initially used to examine the normal distribution of data. To ensure the homogeneity of the intervention and control groups, the independent t-test was employed for quantitative variables. The Chi-square test was used for categorical variables. Further evaluated was the effect of the educational program on the TPB constructs, PA, and the PCI (at baseline and six months follow-up) in two groups of intervention and control. The paired t-test and t-test were employed to assess the differences within and between groups in terms of continuous variables, including attitude towards behavior, subjective norms, perceived behavioral control, behavioral intention, physical activity (day per week), physical activity (minute per day) and PCI (beat/minute), respectively. Mean scores between the two groups were compared using an independent t-test. Also, we assessed the frequency of PA level and intensity between and within the control and intervention group pre and post-intervention by chi-square test.

Findings

One hundred ten health volunteers with a mean±SD age of 35.71±35.5 participated in this study (Diagram 1). The intervention and control groups were not also significantly different in terms of demographic variables (Table 1).

The paired t-test indicated a significant difference between the baseline and follow-up within the intervention group ($p<0.05$) regarding the mean score of the TPB variables, days and minutes per week for physical activity, and the PCI; no such difference was observed in the control group ($p>0.05$). The independent t-test showed a significant difference between the two groups regarding the variables mentioned above at baseline and post-education ($p<0.05$). However, the subjective norms were not significantly different within and between each group at baseline and post-intervention ($p>0.05$; Table 2).

The within-group responses to the intervention were assessed by calculating the changes in the measures from pretest to posttest, positive values indicating an increase, and negative values indicating a decrease in TPB constructs and variables and indicating an improvement in these variables situation. However, more decreases indicated a better value for PCI. Table 3 Group comparison showed that the differences in attitude towards behavior, Perceived behavioral control, Behavior, Physical activity (day per week), and PCI were significant at a $p<0.05$ level. No significant change were detected for behavioral intention and subjective norms ($p>0.05$; Table 3).

Only 2.7% of the participants were active, and 6.3% had moderate-intensity PA at baseline. The chi-square test indicated a significant difference in the frequency of PA level and intensity before and after education in the intervention group ($p<0.05$). However, this change did not occur in the control group ($p>0.05$). According to the chi-square test, the two groups were significantly different at six months ($p<0.05$; Table 4).

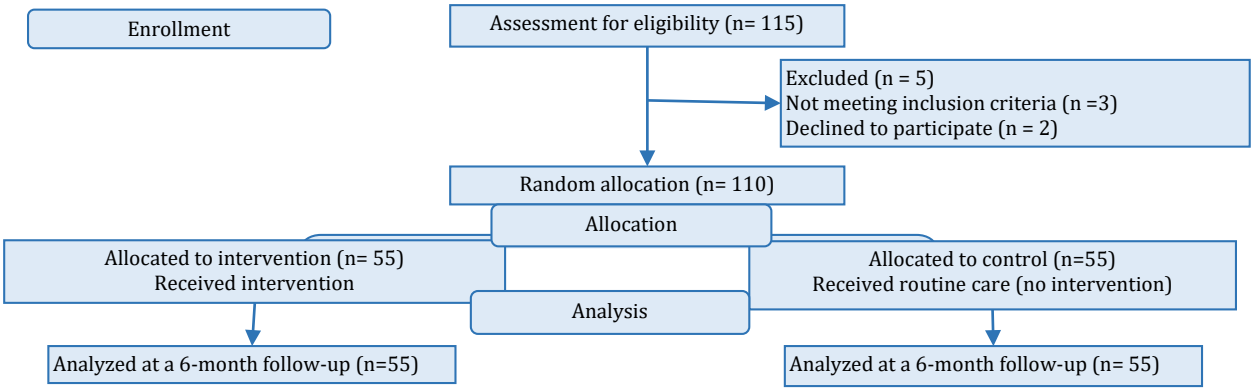

Diagram 1) Flow diagram of the study

Table 1) Demographic and background variables in the intervention and control groups at baseline (n=110)

Variable	Intervention		Control		p-value
	Mean±SD	No. (%)	Mean±SD	No. (%)	
Age	34.37±3.96	-	35.02±4.96	-	0.67*
Number of children	1.78±2.1	-	1.73±2.1	-	0.74*
BMI	26.65±5.15	-	27.02±5.13	-	0.70*
Marital status		-		-	0.90**
Married	-	50 (90.1)	-	48 (87.3)	
Single	-	5 (9.9)	-	7 (12.7)	
Education					0.42**
≤ Secondary	-	23 (41.8)	-	25 (45.4)	
> Higher	-	32 (58.2)	-	30 (54.6)	
Husband's education					0. 94**
≤ Secondary	-	38 (69.5)	-	39 (70.9)	
> Higher	-	17 (29.5)	-	16 (29.1)	
Occupation					0.84**
Employee	-	21 (38.2)	-	20 (36.6)	
Housewife	-	34 (61.8)	-	35 (63.4)	
History of chronic disease					0.99**
Yes	-	4 (7.3)	-	4 (7.3)	
No	-	51 (92.7)	-	51 (92.7)	

*Independent t-test, ** Chi-square test

Table 2) TPB constructs, physical activity, and PCI in the intervention and control groups at baseline and follow-up (Mean±SD)

Group	Baseline	Follow-up	p-value
Attitude towards behavior			
Intervention	18.24±2.16	20.32±3.63	<0.001
Control	18.25±2.12	18.45±2.13	0.87
p-value	0.79	<0.001	-
Subjective norms			
Intervention	11.84±2.69	12.96±2.66	0.65
Control	11.85±2.13	11.87±2.13	0.85
p-value	0.86	0.87	-
Perceived behavioral control			
Intervention	4.65±2.45	6.68±2.15	0.04
Control	4.85±2.43	4.86±4.43	0.83
p-value	0.45	0.01	-
Behavioral intention			
Intervention	11.44±3.15	12.87±2.44	0.03
Control	11.45±3.23	11.44±3.23	0.31
p-value	0.86	<0.001	-
Physical activity (day per week)			
Intervention	1.75±2.17	7.32±0.79	0.001
Control	3.25±2.17	3.25±2.17	0.62
p-value	0.82	<0.001	
Physical activity (minute per day)			
Intervention	71.87±60.54	98.98±55.01	<0.001
Control	84.87±95.64	85.85±98.85	0.53
p-value	0.87	<0.001	-
PCI (beat/minute)			
Intervention	0.55±0.32	0.14±0.11	<0.03
Control	0.53±0.31	0.31±0.53	0.87
p-value	0.73	<0.001	-

Table 3) Comparison of score changes between two groups (Mean change ± SD: Follow-up score-baseline score)

Variable	Intervention	Control	p-value
Attitude towards behavior	2.08±4.62	0.2±3.18	0.015
Subjective norms	1.12±3.84	0.02±3.14	0.103
Perceived behavioral control	2.03±3.34	0.01±5.32	0.019
Behavioral intention	1.43±4.10	-0.01±4.36	0.077
Physical activity (day per week)	5.57±2.43	0.00±2.91	0.0001
Physical activity (minute per day)	27.11±92.49	0.98±130.50	0.229
PCI (beat/minute)	-0.41±0.23	-0.22±0.35	0.001

Table 4) the level and intensity of physical activity in the intervention and control groups at baseline and follow-up

Physical activity	Baseline	Follow-up	Chi-square
	No. (%)	No. (%)	(p-value)
Intervention			
*No Active	40 (72.7)	1 (1.8)	77.165 (<0.0001)
Less Active	13 (23.63)	9 (16.4)	
Active	2 (3.6)	45 (81.8)	
Control			
No Active	42 (76.4)	42 (76.4)	0.000 (1)
Less Active	12 (21.8)	12 (21.8)	
Active	1 (1.8)	1 (1.8)	
Chi-square (p-value)	0.422 (0.81)	81.609 (<0.0001)	-
Intervention			
**Light	49 (89.1)	8 (14.54)	62.168 (<0.0001)
Moderate	4 (7.3)	42 (76.36)	
High	2 (3.6)	5 (9.90)	
Control			
Light	50 (90.9)	48 (82.27)	0.384 (0.82)
Moderate	3 (5.4)	4 (7.27)	
High	2 (3.6)	3 (5.45)	
Chi-square (p-value)	0.153 (92.6)	60.463 (<0.0001)	-

*No active: Zero minutes of moderate-intensity physical activity per week; Less active: Less than 150 minutes of moderate-intensity physical activity per week; Active: 150 minutes or more of moderate-intensity physical activity per week. **Light: Provided that there was no report in the questionnaire and the individuals had no low conditions; Moderate: A combination of moderate and high physical activities or walking during at least five days had reached 600 MET-min/week; High: Total energy spent for high physical activity during at least three days out of the past seven days had reached 1500 MET-min/week or the total energy spent over the past seven days for performing a mix of moderate-intensity activities or walking had reached at least 3000 MET-min/week.

Discussion

This study evaluated the effectiveness of a theory-based health education program on improving PA and PCI among healthy volunteers. Only 2.7% of the health volunteers were adequately active at baseline. Implementing the TPB-based educational program augmented the construct of attitudes towards behavior at 6-months follow-up in the intervention group. Attitudes are moderated based on the consequences of personal experience with behavior; following direct experience with behavior, positive beliefs about the consequences of a behavior are reinforced, later playing the role of motivation for behavior continuation. This result is consistent with the findings of McMillan *et al.* [22]. A clinical trial by Darker *et al.* on walking improvement based on TPB reported a similar increase in individuals' attitudes towards PA [24]. An intervention based on BASNEF Model resulted in a significant rise in the attitudes towards PA among students [25]. However, this finding is not in line with Mok and Lee's study, where the attitude towards PA did not change over the study period [26]. One possible explanation for such a difference may be that positive attitudes towards PA among students were at a high level at baseline.

Moreover, no significant increase was observed in the attitudes of the elderly towards walking in the investigation by Reger *et al.* [27]. Neither did the findings by De meester *et al.* show any significant differences at follow-up [28]. The mean for constructing subjective norms in the intervention and control groups at baseline and follow-up revealed no significant differences. This result is consistent with the investigation of Ahmadi *et al.* on PA among healthcare workers [29]. However, it is not in agreement with previous studies, in which the scores of subjective norms significantly increased at follow-up [15, 30]. It seemed that distributing educational pamphlets among health volunteers did not influence the perceived social pressure. Other educational methods such as educational panel discussions and educational sessions for the family members of health volunteers might positively impact the given construct.

Similar to previous reports [31-33], the perceived behavioral control was significantly improved in the intervention at follow-up. The education helped participants feel that they had enough control over their behaviors and could perform the behaviors under any conditions [34].

Furthermore, the educational program provided for the intervention group increased the behavioral intention at 6-months follow-up. The given results are also in line with earlier reports [24, 28, 29, 35]. In the investigation by Moeni *et al.*, the behavioral intention was considered the most important factor affecting physical activity among university students [36]. In the present study, it seems that presented educational content on the advantages of sports and the disadvantages of physical inactivity, discussing strategies to adopt physical behaviors, including walking, resulted in improvements in individuals' behavioral intention in physical activity.

This study showed the positive impact of educational programs on physical activity behavior in the intervention group. These results were similarly supported in the investigation by De meester *et al.* [28]. Moreover, the findings on physical activity behavior are in line with the results by Sniehotta *et al.* [37], but in contrast with the results of Williams *et al.* on physical activity among

outpatients using TPB [38] and patients with diabetes [39]. This might result from the different characteristics of the populations under study.

The PCI was also employed in the present study as an objective measurement of physical activity, which was reduced significantly in the intervention group than in the control group. This result is in line with Arastoo *et al.* in terms of the effect of aerobics and yoga exercises on PCI among patients [23].

As recommended by the CONSORT group, reporting RCTs of social and psychological interventions [40] should provide readers with how and why PA changes for participants (health volunteers in this study). The study makes it possible for a researcher to replicate such an intervention and healthcare providers to apply for the program.

The present study did not assess participants' body mass index in the posttest, which is a significant limitation. Second, there was no possibility of observing participants in terms of their physical activity program, and only their self-reports in this respect were included. However, the improved PCI is a valuable objective measure to confirm this issue.

Conclusion

The TPB-directed educational program improved physical activity and physiological cost index. The study framework might be used as a practical template for interventions aimed at improving physical activity among women.

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Ethical Permissions: The Ethics Committee of Ahvaz Jundishapur University of Medical Sciences confirmed the morality and ethics of the study (CODE IR.AJUMS.REC.1395.274).

Conflict of Interests: The authors declare that they have no competing interests.

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