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Effect of a theory-based educational intervention for enhancing nutrition and physical activity among Iranian women: a randomised control trial

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Abstract

Objective: The relative contribution of health promotion models (HPM) to improve health-related behaviours in intervention programmes is still limited. Here, we tested whether Pender's HPM operationalised in the educational intervention was effective to modify nutrition and physical activity (PA) behaviours among Iranian women.

Design: A randomised controlled field trial evaluating the efficacy of an educational intervention based on Pender's HPM to improve PA and nutrition behaviours from August 2016 to October 2016. R version 3.0.2 and SPSS version 16 were used to conduct multiple statistical analyses.

Setting: Ten public healthcare centres in Bojnourd, Iran were randomly divided into intervention and control groups. The experimental group received the full intervention programme, which included nine 4-h training sessions and consulting support via phone contact and social media group. The control group did not receive any intervention.

Participants: Women aged 4–6 years (n 202) were randomised to intervention (n 102) and control conditions (n 100) and completed baseline and 3-month follow-up.

Results: In the experimental group, the intervention programme had a significant effect ($P < 0{\cdot}05$) on all construct of Pender's HPM and behaviour outcome, and the estimates for prior behaviours, self-efficacy, interpersonal influences, feeling, perceived benefits and barriers, commitment and behaviour outcomes in the intervention group were 0·72 (95 % CI 0·31, 0·98), 0·54 (95 % CI 0·27, 0·71), 0·74 (95 % CI 0·27, 0·91), 0·52 (95 % CI 0·19, 0·75), 0·62 (95 % CI 0·22, 0·91), 0·63 (95 % CI 0·30, 0·86) and 0·56 (95 % CI 0·37, 0·85), respectively.

Conclusions: Educational intervention based on Pender's HPM was feasible and highly acceptable to modify PA and nutrition behaviours in the women population.

Keywords
Educational intervention
Pender's health promotion model
Physical activity
Nutrition behaviours
Women

Despite considerable attempts have been performed to improve the nutrition and physical activity (PA) behaviours for an entire population, inadequate PA and obesity are generally more prevalent in the world[1,2]. According to the WHO report in 2015, approximately 23 % of adults aged 18 years and over (27 % women and 20 % men) did not have enough activity to achieve health benefits[3,4]. Obesity and overweight are an epidemic among the adult population, particularly in low- and middle-income countries. In 2016, the WHO demonstrated that approximately 1·9 billion (39 %) adults aged 18 years or older were obese and overweight[5]. In Iran, a previous study in 2016 reported that 82 % of adults were either overweight (59·3 %) or obese (22·7 %)[5,6]. Therefore, the obesity rate

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is at an unacceptably high level in Iran and remains a health priority that needs further and maintained educational intervention.

In Iran, despite significant changes in the epidemiological profile of the population, changes in lifestyle, such as increasing irregular eating patterns and the consumption of sugary drinks, combined with insufficient PA, are the main factors in creating an 'obesogenic' society that powers unhealthy behaviour patterns[7,8]. Notably, in Iran, women were less active and more obese than men, and their healthy lifestyle pattern is the primary concern. It seems that Iranian women face unique challenges of religious and cultural barriers that affect healthy behaviours among the women's population[7,8]. As documented by Kulie *et al.* in the USA[9] and Klumb and Lampert in Germany[10], the health education intervention for women allows the improvement of family behaviour patterns and leads their generation to have a better quality of life at any stage of development.

In recent decades, a variety of health promotion models (HPM) have been developed to enhance knowledge in the field of health promotion[11]. Pender's HPM is a theoretical framework for evaluating the determinant that contributes to the promotion of healthy lifestyle behaviours and individuals' commitment to healthy behaviours[12]. This model is derived from the social cognitive theory with nine potential constructs. Individual characteristics and experience (prior behaviours) is the first scale of the HPM model to evaluate experience factors and innate factors that influence health promotion behaviours[13]. The behaviour-specific cognitions and effects are evaluated by the following constructs: perceived barriers, benefits, self-efficacy and activity-related affect. Most HPM research focuses on these constructs to perceive the positive consequences, barriers, beliefs and intentions to engage in a specific healthy behaviour[12,14]. Perceived self-efficacy is a central scale to evaluate personal capability and self-confidence in the development of healthy behaviours. The situational and interpersonal influences are the main constructs to examine the effect of social (family and friend support and interference) and environmental support (home and neighbourhood) on healthy behaviour[12,15]. Commitment to a plan and behavioural outcomes are the target to examine the individuals' belief, intention and health decision-making regarding behaviours end point (online supplementary material, supplemental Fig. 1). This model is implemented in numerous intervention programmes to modify health-promoting behaviours such as taking responsibility for health, nutrition, exercise, stress management and interpersonal support[13,14].

In this respect, this study was designed to evaluate PA and nutrition behaviours to better understand the determinants that influence health-promoting behaviours in women. The main objective of this study was to examine the effectiveness of Pender's HPM-based intervention at improving nutrition behaviours and PA levels among women population enrolled in centre-based healthcare.

Methods

Participants

A randomised controlled field trial evaluated the efficacy of an educational intervention based on Pender's HPM to improve PA and nutrition behaviours. In this study, women were eligible if they: (a) had a history of physical health, (b) were able to complete all relevant questionnaires, (c) were aged 18–50 years and (c) could speak and read their Persian language. Participants were excluded if they: (a) unwilling to participate and (b) had suffered mental disturbance, chronic disease (including diabetes and CHD), visual impairment and upper limb disability because participants with different types of disease and disability need different education programmes based on their physical and mental condition. Therefore, these populations were excluded from this study, and we only included women with health who met inclusion criteria.

Recent studies exploring the effectiveness of HPM's intervention on health promotion behaviours targeting Iranian females showed that all intervention programmes had a small-to-moderate effect (e.g., = 38 %) on changing nutrition behaviours and PA level[8,16]. According to Cohen[17], an experimental study with two groups would need 166 participants (eighty-three participants per group) assuming a small-to-moderate effect, an α of 0·05 and a power level of 0·80. In this study, healthcare centres were considered as units (clusters). Thus, we adjusted the sample size to estimate the clustering effect using the following equation:

$$D = 1 + (k - 1)\,\rho$$

where k is the anticipated cluster size (number of centres); D is the design effect; ρ is the intra-cluster correlation coefficient. In this study, the design effect for ten centres was $1 + 0{\cdot}05\ (10–1) = 1{\cdot}2$. Then, the sample size was estimated to be $83 \times 1{\cdot}2 = 100$ for each group. We assumed a loss to follow-up rate of 20 %; our final target was to recruit at least 240 women (120 per group) from ten healthcare centres. All eligible participants filled out consent and completed study instruments.

Randomisation and recruitment

This study was conducted from April 2016 to February 2017, among the population of women living in Bojnourd, Iran. The intervention was conducted from August 2016 to October 2016 (see Fig. 1). Random allocation of healthcare centres was done before individual recruitment based on the consort checklist and flow diagram (Fig. 2). Ten healthcare centres were randomly selected from a list of centres. We randomly assigned these centres to the intervention (n 5) and control (n 5) groups. In each centre, the health secretary provided a list of women based on demographic data and health history, and all the women were assigned a number. Then, we used tables of random numbers to select each number of the women.

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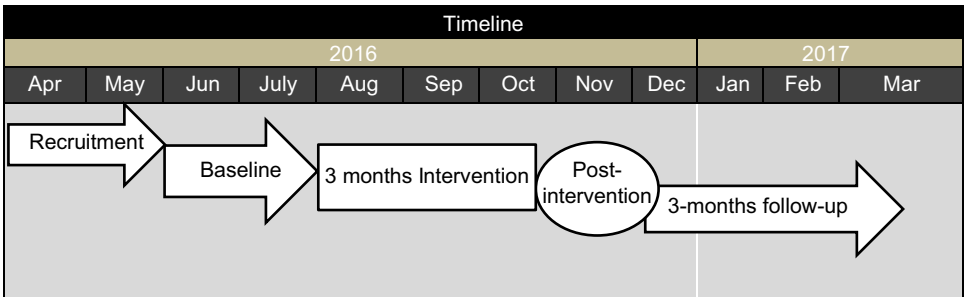

Fig. 1 (colour online) Intervention timeline for the supporting healthy behaviours (physical activity and nutrition behaviours)

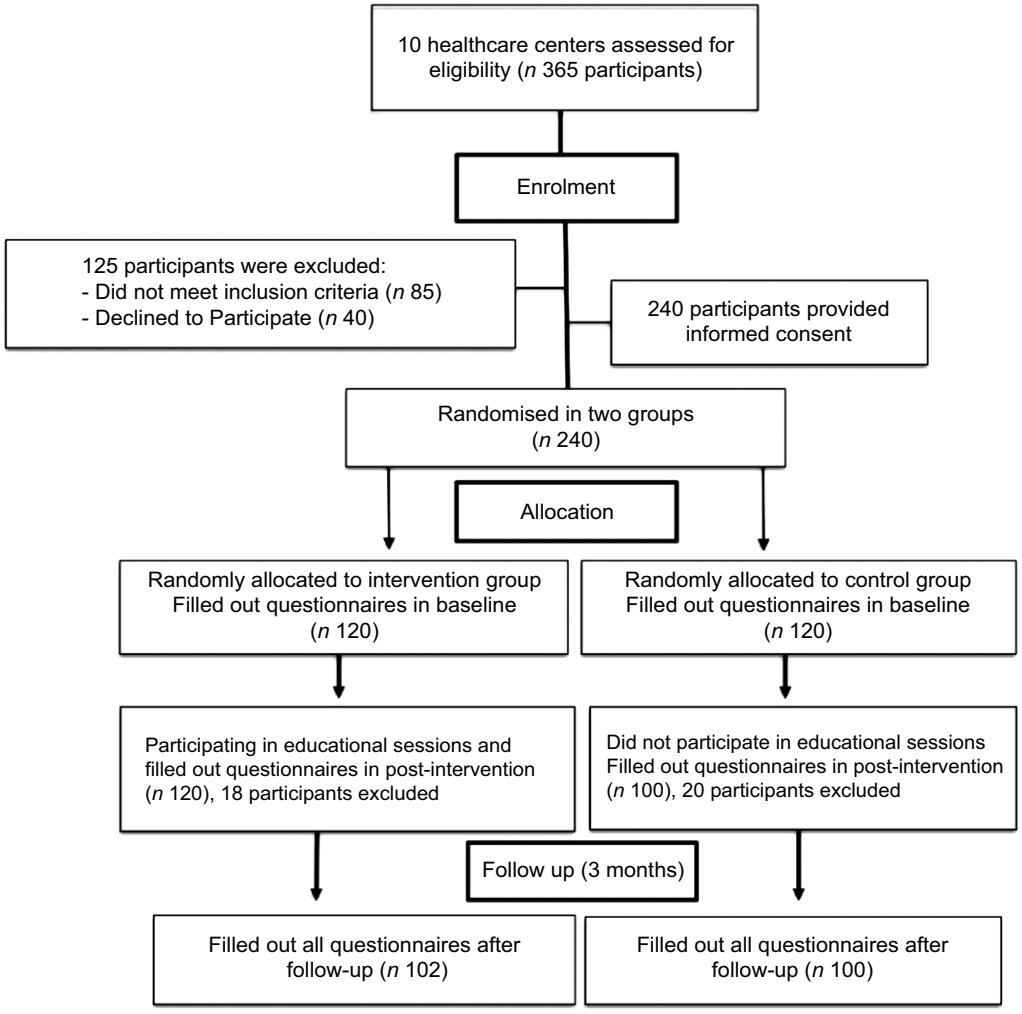

Fig. 2 Flow of participants through each stage of the programme

Briefly, 365 women were randomly selected, of whom 125 have not met inclusion criteria, and thirty-eight participants refused to participate in follow-up because of the travelling (*n* 12), pregnancy (*n* 10) and employment problems (*n* 16). Finally, 202 women were included in the data analysis, and they completed the baseline (before intervention) and follow-up (post-intervention and 3 months after intervention) process (Fig. 2).

Intervention

The intervention was undertaken based on the Template for Intervention Description and Replication checklist (Table 1)[18]. The Pender's HPM was used as a guide to develop the intervention because it is an appropriate social–ecological model for evaluating the determinants that promote healthy lifestyle behaviours and individuals' commitment to healthy behaviours (online supplementary

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Table 1 Template for Intervention Description and Replication checklist of the study

Items	Description
BRIEF NAME	Theory-based intervention for improving nutrition and physical activity behaviours
WHY (Rationale of treatment)	Inadequate physical activity and obesity are associated with increased risk of falls in women affected with morbidity in world. Therefore, an educational intervention, including theory-based health education training, is recommended. The main aim of this RCT was to evaluate whether the Pender's health promotion model operationalised in the educational intervention is effectiveness to modify nutrition and physical activity behaviours, and reported promising preliminary results to gain a better understanding of health-promoting behaviours and their determinants to promote women's health and quality of life
WHAT (Materials)	The intervention is informed by Pender's health promotion model (HPM), which defines behaviour as a mutual and dynamic interaction of personal characteristics, behaviour, and situational and interpersonal influences. The intervention targets key constructs of the Pender's HPM to change women's behavioural capability, perceived self-efficacy, feeling, interpersonal and situational influences, perceived benefits and barriers, and commitment to a plan of action
WHAT (Procedures)	This RCT included intervention and control groups. Experimental group received the full intervention programme and consulting support. Control group did not receive any intervention. Nine training sessions were scheduled with focus on the key constructs of the Pender's HPM that was explained with details in Table 2
WHO PROVIDED (Profession, expertise, background, specific training)	A qualified exercise specialist, dietician (first session) and training health educator (sessions 2–9)
HOW (modes of delivery)	In intervention group: nine training sessions were conducted face to face, and consulting support was conducted by phone contact and internet messaging service such as telegram channel. Control group did not receive any training and counselling
WHERE (Infrastructure and relevant features)	Health education and health promotion service in a public healthcare centre
WHEN and HOW MUCH (Number of sessions, duration, intensity or dose)	Each participant underwent a training programme consisting of nine, 4-h sessions, every 10 d for nine consecutive 10 d
TAILORING (Personalisation)	Using teach-back video, educational pamphlets, review action planning reminder card and focus group dissection; consulting support, and standardising each sessions in its duration and intensity
MODIFICATIONS	No modifications occurred to the planned intervention during the training
HOW WELL: planned (Adherence and procedure to maintain it)	Adherence to the protocol intervention was optimal for all participants and thirty-eight participants refused to participate in follow-up because of the travelling, pregnancy and employment problem
HOW WELL: actual	The complete (100 %) scheduled intervention programme was delivered, without any deviation from the planned protocol

material, supplemental Fig. 1). This model recognises that multiple levels of influence affect behaviours and that health interventions are effective when they aim at changes in environmental domains, perceived self-efficacy, feeling, perceived benefits and barriers, and situational and interpersonal influences. The intervention group received a 3-month intervention that included nine 4-h training sessions (every 10 d) with a focus on the key constructs of the Pender's HPM, which are detailed in Table 2. Likewise, consulting support was conducted by phone contact and internet messaging service to encourage women to be more active and to make better healthier diet and food selections. Educational intervention was conducted by a qualified exercise specialist, dietician (first session) and training health educator (sessions 2–9).

We also used teach-back video, educational pamphlets, review action planning reminder card and focus group dissection to conduct intervention. All details related to dissemination/instruction's intervention are described in Table 2. Subjects in the control group had not received any training during the intervention period, and they accessed a lifestyle-training package after 6 months when the health intervention and the 3 months of follow-up periods were finished.

Tools of assessment

The outcome of this study was to improve nutrition and PA behaviours based on changing women's perceived self-efficacy, feeling, interpersonal and situational factors, perceived benefits and barriers, and commitment to a plan of action. The intervention based on Pender's HPM was the independent variable, and the covariates studied were demographic characteristics including age, education, gender, income, employment status, marital status, height, weight, number of children and homeownership.

In this study, we used the nine constructs of Pender's HPM as a framework to design the nutrition and PA questionnaires. To design the HPM items, we studied the literature of the HPM model[12] and interviewed thirty women to collect their opinions concerning nutrition and PA behaviours. Then, an expert panel of ten specialists in exercise, health education and diet edited all the questionnaires.

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Table 2 A Pander's HPM-based educational intervention to improve physical activity and nutrition behaviours

Times	Key constructs of the Pender's HPM	Intervention method	Intervention's instruction
Sessions 1, 2	Individual characteristics and experiences	Lecture, slides, teach-back video, educational pamphlets, review action planning	1. Incorporating key concepts to clarify woman's needs to promote healthier active lifestyles based on: focused on lifestyle determinants of health, obesity prevention; descriptions of risk factors and positive effect of healthy activities; 2. Development of appropriate guidelines and methods to increase knowledge and commitments of women based on: provide an overview of food and nutrition needs; set goal to use healthy cooking based on the five main healthy food groups and reduce low-nutrition and energy-dense foods; set goal to increase appropriate physical activity levels and how often to walk, and reduce screen and setting time
Session 3	Self-efficacy	Lecture, slides, teach-back video, prompt self-care behaviour and self-monitoring	Promoting individual capability and self-confidence to modify desired healthy behaviour based on: Identification of self- monitoring; Deliver positive feedback and verbal persuasion; Know how to improve the strength of the participants' belief and awareness in their ability to engage in physical activity and healthier diets on a regular basis despite various conflicting situations such as setting realistic goals to start gradually and slowly increase time of activity per day or increase small changes that could be made to healthier diets
Session 4	Perceived-barriers	Lecture, group discussion, barrier/benefit identification, reminder card, pamphlets	- Identify barriers perceived as preventing women from performing physical activity and trying to eat healthier foods: for example, personal (family obligations, lack of knowledge and skills, health problems, low self-efficacy), economy and environmental barriers - Individual counselling on strategies to overcome perceived barriers by future replace activities; commitment to be physically active was emphasised
Session 5	Perceived benefits		- Improving levels of agreement regarding perceptions and commitments about expected benefits such as prevention of chronic diseases, decreased nervousness and fitness and staying young
Session 6	Activity-related affect	Lecture about enjoyment scale; reminder card; prompting focus group on past success	-Improving positive emotions or affect towards healthy behaviours to increase perceived self-efficacy and the probability of commitment - Help plan enjoyable activities into schedule
Session 7	Interpersonal influences	Group discussion and brainstorming plan social support/social change lecture, slides, teach-back video	- Encouraged to develop social network (family and friends, social norms) by asking friends and family to be active with them or provide support to do so (family contract, encouragement, reward) - Sharing commitment and increasing communication with persons who are physically active or use healthy diet
Session 8	Situational influence		- Help to improve their perceptions about safe locations for favourite activity (walking environment in home and neighbourhood) - Help to improve their perceptions about cost, availability and quality of food in home and neighbourhood
Session 9	Behaviour outcome	Lecture, slides, group discussion on resistance training and training adherence	Increase awareness and commitment to desired behavioural end point or outcome of health decision-making and preparation for action: familiar with rate of perceived behaviour cognitions
From session 1 to session 9	Counselling support	Women received further information via phone contact and internet messaging service such as telegram channel	- Help to set and review personal goals and strategies to overcome barriers and select healthier foods - Remind them how to select determine types, intensity and duration activity

They evaluated the necessity and relevance of all items to quantify the content validity index and content validity ratio. In this investigation, the average content validity ratio for the nutrition and PA behaviours questionnaires was 0·88 and 0·98, and content validity index for these questionnaires was 0·94 and 0·92, respectively.

We pilot tested the questionnaires with fifty women to evaluate all items based on their clarity, readability and simplicity[19]. The reliability coefficients (Cronbach's α) of nutrition and PA behaviour questionnaires were 0·88 and 0·85, respectively, indicating a strong internal consistency of the questionnaire's criterion[20]. The correlation coefficient between all constructs was more than 0·65, which was considered satisfactory[21]. Eligible participants in both groups completed instruments at baseline (before intervention), immediately after the intervention, and at 3-month follow-up. A demographic questionnaire was only completed at baseline.

Nutrition behaviours

Diet characteristics and experiences were evaluated using a semi-quantitative FFQ[22]. On this scale, twenty short items on food habits (food consumption from main healthy food groups and low-nutrition/energy-dense foods, breakfast consumption) (online supplementary material, supplemental Table 2) with a five-point scale ranged from 0 (never) to 4 (always). Cronbach's α of this construct was 0·85. Perceived self-efficacy was examined by eight items based on existing diet self-efficacy scale (e.g., how much degree of confidence do you have to make a better food selection even if you were tired?), which were ranged on a five-point scale from 0 (no confidence) to 4 (great confidence)[23,24].

We also used six items to assess activity-related affect (e.g., eating healthy food groups and breakfast is enjoyable to me) with a five-point scale ranging from 0 (completely disagree) to 4 (completely agree). Perceived barriers and benefit constructs contain six and eight items, respectively. Participants were asked to rate how much they agree with the perceived barriers (e.g., I could not perform regular healthy cooking if I don't have enough money, or I don't like eating breakfast early in the morning) and perceived benefits (e.g., a reason I eating healthy food groups, I feel they improve my physical appearance/or decrease my nervousness; I eating breakfast because it decreases the consumption of low-nutritional snacks)[24,25]. Items in these constructs were ranged from 0 (completely disagree) to 4 (completely agree). We used two items to examine an individual's commitment (e.g., do you have a regular schedule to use healthy food groups? or do you have a commitment to your regular schedule regarding healthy diets?). Items of this scale were rated from 0 (never) 4 (always)[25]. We used ten items to measure interpersonal influences (e.g., how often does your husband/parents expect you to eat breakfast every day? or does your parents/husband expect you to do healthy cooking?). All questions were estimated on a five-point scale ranging from 0 (never) to 4 (always). A situational influence was measured using four items (e.g., I think it is easy for me to access healthy food groups in the neighbourhood) with a five-point Likert scale ranging from 0 (completely disagree) to 4 (completely agree). A behavioural outcome was measured using four items (e.g., how many times during the week do you eat five main healthy food groups?) with a five-point Likert scale ranging from 0 (never) to 4 (always)[24].

Physical activity behaviours

PA is defined as 'any bodily movement produced by skeletal muscles that requires more energy than resting, such as walking, cycling, or participating in sports – these have significant benefits for health'[26]. We used the long version of the self-administered International Physical Activity Questionnaire (IPAQ-L) to measure the individual PA characteristics and experiences over the week (MET-min/week) (see online supplementary material, supplemental Table 3)[27,28]. This questionnaire includes twenty-four validated short questions on regular PA (frequency and duration of work, leisure, household/yard activities and commuting during the last 7 d) to evaluate the individual's experiences that influence the level of PA. Cronbach's α on this scale was 0·83. The scale of self-efficacy contained eight items (e.g., how much degree of confidence do you have to conduct PA even if you were tired?) with a five-point scale ranging from 0 (no confidence) to 4 (great confidence)[23]. Activity-related affect was measured using five items (e.g., how much they agree with PA behaviour enjoyment or affect), which were ranged from 0 (completely disagree) to 4 (completely agree). Perceived barriers and benefit constructs contain twenty items. Participants were asked to rate how much they agreed with the perceived barriers (e.g., I might not do regular PA if I did not have enough time) and perceived benefits (e.g., one of the reasons I do regular PA is that I believe exercise improves my physical appearance/or decreases my nervousness). Items in these constructs ranged from 0 (completely disagree) to 4 (completely agree)[29,30]. Commitment to a plan contains two items (e.g., do you have a regular schedule to perform PA?) with a two-point scale rating from 0 (no) to 1 (yes)[12]. Interpersonal influences were measured using eight items (e.g., how often does your husband/parents change their schedule so they can exercise with you? or my parents/husband expect me to exercise) on a five-point Likert scale ranging from 0 (never) to 4 (always). We measured situational influences using six items (e.g., I think it is easy for me to access exercise facilities/in home/neighbourhood, I think that the cost of exercise is reasonable in my city). This construct was rated from 0 (completely disagree) to 4 (completely agree)[29,30]. We used eight items to assess health outcomes (e.g., I consider regular schedule to

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perform PA during the week, I manage my time to engage in regular PA despite various conflicting situations), which rated from 0 (never) to 4 (always)[12].

Statistical analyses

In this study, descriptive analysis was done using mean score and standard deviation. The bivariate analyses (*t*-test, chi-square, ANOVA) were used to compare variables between the control and experimental groups. The bivariate correlations between the outcome variables and covariates were analysed using Pearson's correlations. A repeated measure ANOVA was also used to determine differences in outcome variables from baseline to follow-up in control and intervention groups.

The random affects least squares regression model was used, with the main effects of study arm assignment (control *v.* intervention), time period (baseline *v.* follow-up) and their interaction included. This model decreases concerns regarding missing data because all errors are shaped within the design as a random effect. Likewise, this analytical model allows for the accounting of cluster effects between behaviour outcomes and HPM constructs that are nested within an intervention programme. We assumed health promotion intervention to be nested within modifying healthy behaviours via the Pender's constructs. Regression analysis involved adjustment for baseline covariates that had a significant effect on outcomes because the main target in this study was only testing the effectiveness of the HPM model and their constructs on improving nutrition and PA behaviours. The estimated parameters for the determinants of healthy behaviours are accompanied by their 95 % CI. Significant differences were taken as $P < 0{\cdot}05$, and R version 3.0.2 and Statistical Package for Social Sciences software (SPSS 16) were used to conduct multiple statistical analyses.

Results

At baseline, there were no significant differences ($P > 0{\cdot}05$) in the demographic measures from control and intervention groups. The result showed that the mean (±SD) of age, weight and height for the eligible participants were 30·05 (±9·4), 61·3 (± 8·8) and 161·2 (±5·4), respectively. A majority of the eligible women were married (88 %), housekeepers (88·2 %), moderate-income families (65 %), high school diploma (34 %) or bachelor's degree (26 %) with three or four children (Table 3). In this study, we observed that the women's physical and nutrition behaviours were significantly correlated with their educational level, number of children, employment status and family income (Table 3).

At baseline, all of HPM's constructs were homogeneous in intervention and control groups. The results related to the PA behaviours showed a significant difference ($P < 0{\cdot}05$) in the change in all constructs of Pender's HPM (except situational influences) in the intervention group compared with the control group at follow-up, and in change from baseline to follow-up in all scores. Our finding linked to nutrition behaviours showed the evidence of significant improvement ($P < 0{\cdot}05$) in prior behaviours, self-efficacy, perceived barriers/benefits, commitment and behaviour outcomes in the intervention *v.* control groups at follow-up, and in change from baseline to follow-up. We found no evidence of any significant differences ($P > 0{\cdot}05$) in the change in construct of Pender's HPM, PA and nutrition behaviours in the control group at follow-up (Table 4). This result was synchronous with the regression models that showed significant interaction effects between time and groups. The results of this study showed that among the women in the intervention group compared with the control group, prior behaviours ($P \leq 0{\cdot}001$), self-efficacy ($P \leq 0{\cdot}001$), interpersonal influences ($P \leq 0{\cdot}001$), feeling ($P = 0{\cdot}001$), perceived benefits and barriers ($P = 0{\cdot}002$) and commitment to a plan of action ($P \leq 0{\cdot}001$) were significantly changed across time during baseline through follow-up (Table 5).

Discussion

We conducted this study to evaluate the effectiveness of Pender's HPM on improving the PA and nutrition behaviours in Iranian women.

Prior-related behaviour is the main construct of the HPM model that influences individuals' characteristics and experiences[15,31]. In the first session of intervention, the participants with low education (under diploma level) lack appropriate experience in health-promoting behaviours. These participants believed that they have low capabilities on their functioning to PA (low self-efficacy) and expressed they lack adequate knowledge in recognising healthy food groups, but a significant increase in the average score of individuals' characteristics and experiences was observed in the intervention group in post-intervention and follow-up. This might be due to the increase in their knowledge and commitment to healthy behaviours. Specific findings from this study indicated that more than 77·1 % of the women in the intervention group had breakfast, used the five main healthy food groups, replaced consumption of sugar-sweetened beverages with water and reduced low-nutrition and energy-dense foods (snacks and fast food) after the intervention. Participants (65 %) engaged in PA, during the intervention, gradually increase the duration of appropriate PA that could be realistically fit into their particular lifestyle and daily schedule. This result was consistence with previous studies that found an increase in individual's awareness that could be made to a higher stage of change and commitments to modify the level of PA[30,32] and healthy nutrition behaviours[24,33].

Similarly, in support of the study hypothesis, the participants in the intervention group reported high levels of

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Table 3 Participant's socio-demographic characteristics and healthy behaviours

Characteristics	Intervention group (*n* 102)		Control group (*n* 100)		Total (*n* 202)		†*P*-value	‡*R*-value	§*R*-value
	n	%	*n*	%	*n*	%			
Mean weight (kg)									
Range: 40–115									
Mean	60·9		61·3		65·8		0·5	−0·09	−0·11
SD	11·3		8·8		12·6				
Mean height (cm)									
Range: 137–190									
Mean	162·07		161·2		166·8		0·8	0·105	0·09
SD	7·7		5·5		6·1				
Mean age (years)									
Range: 18–60									
Mean	28·9		30·05		30·05		0·55	−0·18	−0·12
SD	8·4		9·4		9·4				
Menopause status									
Yes	22	21·5	20	20	42	19·9	0·5	0·09	0·11
No	80	78·5	80	80	160	80·1			
Education level									
Illiterate	16	15·2	20	20	36	17·8	0·44	**0·47	**0·58
< Diploma	22	22·1	26	26	48	23·8			
Diploma	36	35·8	32	32	68	33·7			
Higher education	28	27·5	22	22	50	24·8			
Employment status									
Un-employed	92	90·2	84	84	176	87·1	0·76	*0·37	**0·42
Employed	10	9·8	16	16	26	12·9			
Marital status									
Married	86	84·3	88	88	174	86·1	0·62	0·09	0·11
Single	12	11·8	10	10	22	10·9			
Widow	4	3·9	2	2	6	3			
Income									
Low	36	35·3	38	38	74	36·6	0·82	*0·24	**0·67
Moderate	66	64·7	62	62	128	63·4			
Number of children									
1–2	26	25·5	20	20	46	22·8	0·76	**0·59	0·12
3	30	29·4	40	40	70	34·6			
4	28	27·5	24	24	52	25·7			
5	10	9·8	10	10	20	10			
5–10	8	7·8	6	6	14	7			
Home ownership									
Owner	58	56·9	52	52	110	52·9	0·42	0·05	0·08
Tenant	44	43·1	48	48	92	47·1			
Comorbid conditions									
Yes	10	9·8	10	10	20	9·8	0·86	0·17	0·15
No	92	90·2	90	90	182	90·2			
Physical activity behaviours									
Range: 995–2807									
Mean	1840		1803		1821·5		0·15	1	*0·25
SD	1632		1589		1610				
Nutrition behaviours									
Range: 28–52									
Mean	40·27		40·3		40·13		0·94	*0·25	1
SD	8·43		6·37		7·02				

n, number of eligible participants.
*Correlation is significant at the 0·05 level.
†Testing significant change between control and experimental groups.
‡Testing correlation between physical activities behaviours and demographic characteristics.
§Testing correlation between nutrition behaviours and demographic characteristics.
**Correlation is significant at the 0·01 level.

agreement regarding perceptions and commitments about expected barriers and benefits of regular PA and eating habits, when compared with the control groups at the post-intervention and follow-up. The majority of participants (85 %) in our focus groups indicated that cultural and social barriers (e.g., their traditional role at home, particularly responsibility for their spouse and children, spouse opposition due to fear of harassment), employment status, religion and policy effects (Muslim religion, hijab bans) may have influenced their ability or willingness to participate in regular PA. Similarly, we discovered that PA was negatively and significantly correlated with the

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Table 4 Average scores for HPM's constructs from baseline to follow-up for physical activity and nutrition behaviours

Variables	Pre-intervention					Post-intervention					3-month follow-up					From pre *v.* follow-up (6 months)	
	Intervention		Control			Intervention		Control			Intervention		Control			Intervention	
HPMs' construct (*n* 202)	Mean	SD	Mean	SD	*P value	Mean	SD	Mean	SD	*P valve	Mean	SD	Mean	SD	*P value	** *P*-value	Control ** *P*-value
PA behaviours																	
Prior behaviour	1840	1632	1803	1589	0·15	2423	1092	1792	1497	0·03	2649	902	1·01	0·003	0·021	0·022	0·32
Perceived self-efficacy	12·2	8·04	10·8	7·3	0·35	16·2	7·1	11·1	2·19	0·001	18·5	9·1	12·1	4·09	0·001	0·02	0·41
Activity-related affect	10·45	2·6	10·7	2·2	0·5	13·1	1·61	11·1	1·02	0·001	12·2	2·01	10·8	1·31	0·001	0·001	0·63
Perceived barriers/ benefits	48·9	10·1	49·45	7·6	0·76	52·9	9·12	47·12	8·1	0·001	56·3	8·3	48·9	6·12	0·001	0·001	0·36
Commitment	4	0·001	1	0·002	0·48	1·63	0·06	1·08	0·003	0·001	1·73	0·02	1·02	0·001	0·001	0·01	0·68
Interpersonal influences	10·9	7·4	11·6	7·3	0·62	16·4	9·7	10·9	8·2	0·02	15·4	8·3	12·1	6·15	0·02	0·03	0·59
Situational influences	4·7	2·5	4·7	2·6	0·99	5	1·6	4·2	1·9	0·11	4·9	1·6	4·4	2·78	0·13	0·15	0·31
Behaviours outcome	6·9	5·5	7·7	4·6	0·31	14·9	8·23	6·9	3·1	0·001	16·4	9·5	6·02	2·1	0·001	0·001	0·11
Nutrition activities																	
Perceived self-efficacy	22	6·5	22.	7·02	0·72	25·03	5·7	21·1	6·01	0·001	27·31	3·1	21·01	7·03	0·001	0·001	0·16
Activity-related affect	19·03	5·1	20·01	5	0·91	21·3	5·03	20·2	5·11	0·15	21·71	2·03	19·73	3·11	0·07	0·06	0·26
Perceived barriers/ benefits	48·9	10·1	49·45	7·6	0·76	54·21	7·1	45·9	8·4	0·001	56·3	8·3	49·8	7·4	0·001	0·001	0·44
Commitment	4	0·16	4	0·6	0·71	6	1·5	4	0·23	0·001	6·5	0·8	3·7	1·23	0·001	0·001	0·07
Interpersonal influences	13·01	5·1	13·1	5·08	0·77	15·2	3·9	14·1	2·03	0·72	14·7	5·5	12·6	4·33	0·72	0·055	0·11
Situational influences	3·5	0·04	3·02	0·01	0·87	3·81	0·02	2·9	0·12	0·062	3·67	0·32	3·12	0·04	0·074	0·25	0·085
Behaviours outcome	7·6	4·4	7·9	4·2	0·73	10·6	3·1	7·34	4·1	0·001	11·03	3·1	8·04	2·3	0·001	0·001	0·12

n, number of eligible participants.
*Testing significant change between control and intervention groups.
**Testing significant change from pre-intervention to 3-month follow-up.

Table 5 Interaction of intervention with time period for each HPM's constructs

HPM's constructs*	Estimated parameter	SE	95 % CI	*P*-value
Prior behaviours	0·72	0·18	0·31, 0·98	0·001
Perceived self-efficacy	0·54	0·13	0·27, 0·71	0·001
Feeling	0·52	0·21	0·19, 0·75	0·001
Perceived barriers/benefits	0·61	0·11	0·22, 0·91	0·002
Commitment	0·63	0·12	0·30, 0·86	0·001
Interpersonal influences	0·74	0·23	0·27, 0·91	0·001
Situational influences	0·54	0·33	0·17, 0·47	0·07
Behaviour outcomes	0·56	0·13	0·37, 0·85	0·001

*Adjusted for number of children, employment status, income and level of education.

number of children and employment status, most likely due to having a high responsibility for childcare and working outside the home. Therefore, these participants lack adequate time and so take time out to do some PA. In the intervention group, most of the participants learn how to use replacement strategies to overcome perceived barriers, a commitment to be physically active and use the five main healthy food groups. Moreover, the intervention had significant effects on increasing positive feelings of healthy behaviours in the intervention group as compared with the control group. These findings support other HPM studies that identified the perceived barriers and benefits as the most influential factors to institutionalising behaviours in families[33,34].

In this study, the participants in the intervention group also reported a greater change in the mean score of perceived self-efficacy after the intervention, which was consistent with the results of other similar studies using the Pender's HPM[8,24,35]. During the educational intervention, all participants learned how to set realistic goals to increase their commitment and time to perform appropriate PA per day or increase small changes that could be made to have healthier diets. Therefore, most of the participants in the intervention group have higher individual capability and self-confidence to perform appropriate behaviours regularly even in conflicting situations.

The mean score of interpersonal influences was significantly improved after intervention in the intervention group because they significantly developed their social networking and communication with their family members (brother, sister, husband and parents) and friends to share their attitudes towards nutrition and PA behaviours. Likewise, they had effectively convinced their families to support (encouragement) them to participate in regular PA or to follow a healthy diet. Several studies reported that people are more likely to perform healthy behaviours when they feel their relatives and friends encourage them frequently to perform those behaviours[36–38]. This finding highlighted the role of family members (particularly the parents and husband) and friends as influential people on healthy behaviours in terms of interpersonal modelling, which is in agreement with other health promotion studies using Pender's model. Moreover, Fleury *et al.* suggested that, when designing health promotion programmes to modify the healthy behaviours of women, other family members should be encouraged to be positive role models by targeting their healthy behaviours[39].

The present results demonstrated that the education intervention was able to increase the perception of situational influence in an experimental group after the intervention. However, this change was not significant in this work. This could be due to economic problems, cultural and social (policies and regulations) barriers. Findings showed that family income had a significant correlation with nutrition behaviours in the both groups. This result was confirmed by other educational studies that reported that a family's income is an influential factor that can increase the frequency of healthy food consumption and food quality among women[8,40]. Likewise, all participants addressed concerns about undertaking PA in the natural environment such as polluted weather, a lack of natural settings and exercise facilities, a lack of suitable streets and sidewalks, a great distance to travel to the gym and inadequate transportation. Thus, it is necessary to set an appropriate educational intervention for a better understanding of the barriers and facilitators that are needed for PA promotion among Iranian women.

Strengths of the study

This study is one of the first to test the effectiveness of educational intervention using all constructs of Pender's model (HPM) on improving the PA and nutrition behaviours among a Muslim women population. Testing the application of the theoretical model in different populations is important in moving the theory forward and understanding the crucial components in successful interventions. Likewise, it is essential to test the mediator's constructs to find out how they change behaviour outcomes and support people's abilities to commit to behaviours. A unique aspect of the present research was that all of the positive effects of the HPM intervention were sustained at the 3-month follow-up, particularly on self-efficacy, perceived benefits, perceived barriers and interpersonal influences. This success of the HPM intervention may be related to useful theoretical mediator constructs (such as behaviour-specific cognitions and affect) or it may be due to specific behaviour change techniques such as setting out goals or having focus group discussions. Similarly, Van Sluijs *et al.* found positive effects of the HPM intervention on successful behaviour changes at a 3 or 6-month follow-up[30,41]. This finding will provide a basis for future education interventions aimed at promoting healthy behaviours. In addition, this research is feasible and highly acceptable as it requires minimal investment and time by the training of health provider in healthcare centres; the PA nutritional training programme is

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simple enough that the health provider could be trained to perform it as well. In addition, the training programme is simple to adapt into the daily schedule of the women.

Limitations

The present study is subject to some limitations. Firstly, the results were assessed using a self-report questionnaire, which introduces the possibility of biased results. A second limitation is that mediator questions may not reflect all aspects of HPM's constructs in a natural setting. However, we would not have expected this to affect our results because the test–retest reliability of these questionnaires was more than 0·9 in this study. The final limitation is that the mediator items may not have been sensitive enough to detect all changes over the 3-month intervention, particularly mediators of dietary change, due to the complexity and multiple dietary behaviours that were targeted in the intervention (vegetables, fruit, salt, fat, energy, meat consumption), and the lack of validated and brief items. Future research is still needed to use a behaviour promotion model to test their specific change constructs in different intervention programmes. Further studies should be conducted to sustain a positive behaviour change after the end of the intervention programme. As a fact, maintenance of behaviour change and identification of differences in mediators of behaviour change are part of a field that requires further interventions in the future.

Conclusion

In recent decades, international efforts towards change in policy indicated obesity requires attention among women, particularly in low-moderate socio-economic countries, and intervention strategies based on behaviour change theory are recommended to combat the 'obesogenic' environments. Therefore, we attempted to implement theory-based interventions aimed at promoting healthy eating habits and PA that had a significant impact on healthy behaviour promotion. Our finding highlighted the impact of intervention programmes based on HPM on strengthening PA and nutrition behaviours. A significant change was demonstrated in PA and nutrition behaviours in the intervention group that was also sustained at the 3-month follow-up. Likewise, the utility of Pender's HPM constructs for promoting nutrition behaviour and PA was supported, since individuals in an intervention group moved to a higher stage of change if they had a greater perception of self-efficacy, benefits and barriers to healthy behaviours. It appears that the use of Pender's HPM and its potential constructs could offer a promising way to develop critical techniques to behaviour change success. This has important implications for policy makers and researchers. Cultural and social policies (their traditional role at home, particularly responsibility for their spouse and children, spouse opposition due to fear of harassment), employment status, religious condition, number of children and economic problems have also been identified as major barriers affecting women's ability or willingness to participate in regular PA and healthy dialysis. Therefore, to achieve a healthy lifestyle among women, appropriate training programmes must be systematically and formally implemented in healthcare facilities.

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Supplementary material

For supplementary material accompanying this paper visit https://doi.org/10.1017/S1368980021002664

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