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Original research article

Exploring the impact of health belief model-based nutrition education on promoting preventive nutritional behaviors in women with polycystic ovary syndrome in Jordan: a randomized controlled trial

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Abstract

Background: Endocrinologists consider polycystic ovary syndrome (PCOS) the most complex disorder among women of reproductive age.
Objective: The purpose of the study was to explore the effect of a nutrition education intervention based on the Health Belief Model (HBM) in promoting preventive nutritional behaviors among women with PCOS.
Methods: A randomized controlled trial was conducted between February 2024 and August 2024. Participants were recruited from eight obstetrics and gynecology private clinics in Amman, Jordan. Participants were randomized into two groups: an intervention group (n = 58) and control group (n = 58). In addition to routine healthcare education, participants within the intervention group received a nutrition education program based on HBM.
Results: For all study variables, there was a significant improvement in the mean scores of HBM constructs, anthropometric measurements, and clinical features in the intervention group ($P < 0.001$). There was also a significant difference in the mean scores of HBM constructs, anthropometric measurements, and clinical features between the intervention group and the control group after three months of intervention ($P < 0.001$).
Conclusion: Providing nutrition education programs based on HBM improves preventive nutritional behaviors among women of reproductive age who suffer from PCOS. Such a model can be used as a framework for formulating advanced educational interventions for PCOS prevention.

Keywords: Health Belief Model; Jordan; Nutrition Education; Obstetrics and Gynecology; Polycystic Ovary Syndrome

Introduction

Polycystic ovary syndrome (PCOS) is considered a heterogeneous endocrine disorder, with a global prevalence of 5–20% among women of premenopausal age (Bozdag et al., 2016). Clinical manifestations of PCOS include hyperandrogenism, polycystic ovaries, and menstrual disorders (Vaidya et al., 2020). Hyperandrogenism is highly associated with symptoms of hirsutism, acne, and alopecia, which can inversely affect the quality of a woman's life (Hollinrake et al., 2007). Moreover, overweight or obesity have been reported in 80% of women with PCOS (Fauser et al., 2012). Several serious complications are emphasized among women with PCOS. These include endometrial cancer, cardiovascular diseases, and type-2 diabetes mellitus (Moran et al., 2010). Anxiety and depression are also considered psychological consequences of PCOS (Kaczmarek et al., 2016). Unfortunately, women who have PCOS and suffer with infertility have a low quality of life (Angin et al., 2019).

The development of PCOS is highly affected by genetic variables through hereditary influences (McPhee and Papadakis, 2010). Environmental variables may also play a key role in the development of PCOS, supporting the assumption that genetic-environment interaction plays a key role in the development of PCOS (Rajbanshi et al., 2023). The recommended guidelines and interventions regarding treatment for PCOS are evidence-based. They concentrate mainly on lifestyle modifications through diet modifications, appropriate exercise, and behavioral changes (Teede et al., 2018). Unfortunately, poor adherence to the necessary lifestyle modifications affects the effectiveness of interventions. Therefore, strong management of PCOS should be based on well-structured educational programs alongside appropriate medical therapy (Teede et al., 2011). In the health education field, the value of these educational programs depends highly on the appropriate implementation of models and theories (Ghaffari et al., 2007).

The term "health education" indicates a group of educational strategies that enhance the ability of individuals to se-

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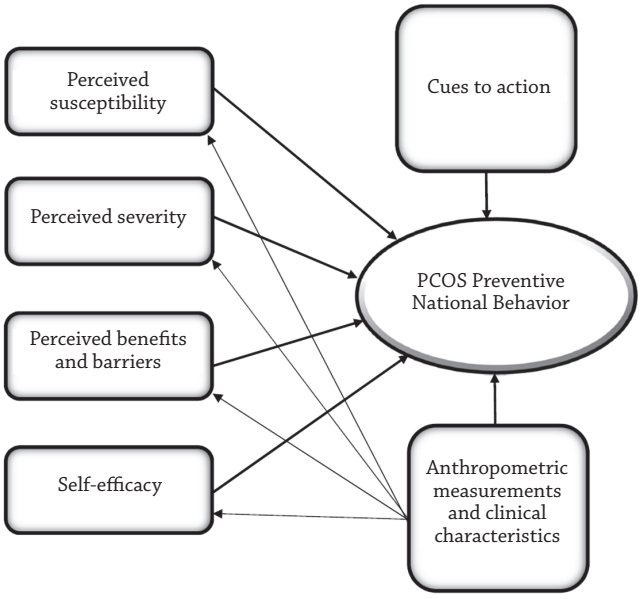
lect and implement healthy lifestyles on their own (Linton et al., 2020). The health belief model is a comprehensive theory used in health education and health promotion as a guiding framework for interventions – and is applied to health-related behaviors (Diddana et al., 2018). It is a psychological model that provides insights regarding how participants may engage in healthy behaviors (Glanz et al., 2008). Interventions based on HBM may help enhance positive behavioral changes (Huang et al., 2025). HBM assumes that an individual's beliefs largely affect his or her preventive behaviors (Guvenc et al., 2011). It is a model that includes several constructs about perceived susceptibility, perceived severity, perceived benefits and barriers, self-efficacy, and cues to action (Scheme 1).

Patients with PCOS need scientific knowledge about the diagnosis, symptoms, etiology and complications of the disease, and the required dietary and lifestyle modifications. To the best of our knowledge, this conceptual theory has yet to be used to promote preventive measures for PCOS among women of childbearing age. The aim of this study was to investigate the effect of HBM-based nutrition education on the promotion of PCOS preventive measures in women of childbearing age.



Scheme 1. Conceptual study framework, based on the health belief model theory

Materials and methods

Study participants

This study used a single-blind randomized controlled trial (RCT). From February 2024 to August 2024, 116 patients with PCOS were randomly recruited from eight private obstetrics and gynecology clinics in Amman, Jordan. All participants were diagnosed with PCOS after fulfilling at least two of the three of Rotterdam's consensus criteria (Rotterdam ESHRE/ASRM-Sponsored PCOS Consensus Workshop Group, 2004). *Inclusion criteria* included: (1) Irregular menstrual cycles >12 months, (2) Body mass index (BMI) ≥25, (3) Sedentary lifestyle. *Exclusion criteria* included: (1) BMI < 25, (2) Using oral contraceptive pills, (3) Being pregnant, (4) Taking medications such as anti-thyroid drugs and anti-uricaemic drugs (Scheme 2). The required sample size was determined according to power analysis (G*Power 3.1). The impact size, power, and margin of error were 0.3, 90%, and 5%, respectively. Participants were randomly assigned to either an intervention group or a control group by a researcher who was blinded to the study design. The study was approved by the Ethics Committee of the Faculty of Agriculture/Mutah University (Approval no.: 2023/12-016), and informed consent was signed by all participants.

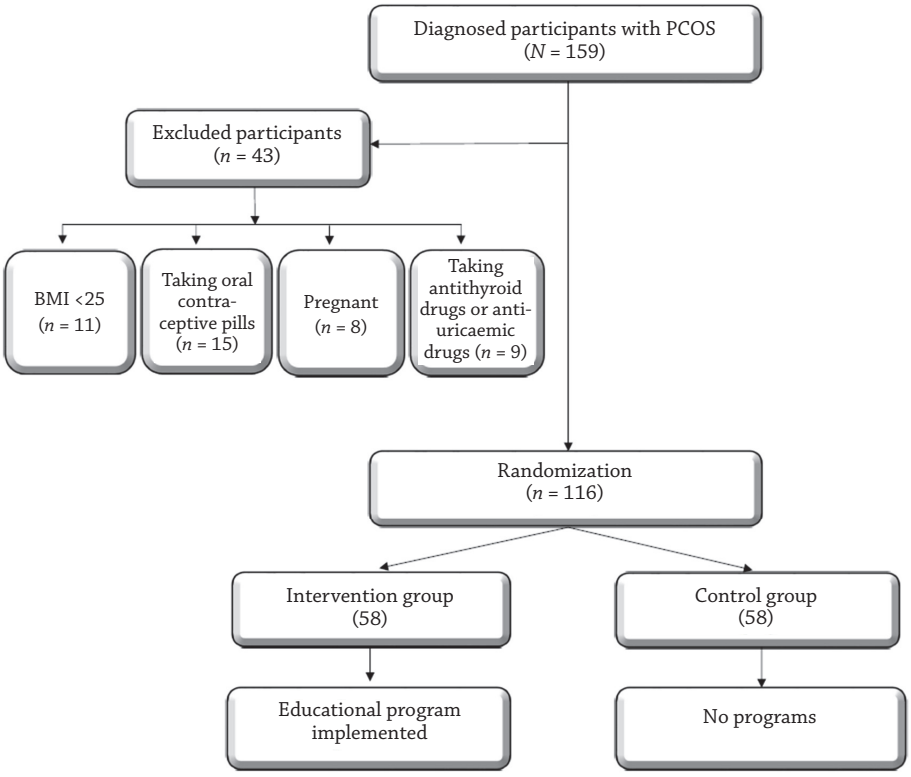
Study instruments

All the patients were female and aged 18–38 years. Anthropometric assessment was conducted via two measurements. The first was body mass index (BMI). This was measured by the formula: BMI = weight in kg/(height in m^2), and the categorization was based on World health organization criteria (WHO, 2003). The second was waist circumference (WC). This measurement was completed twice for each participant, according to Nieman (2019). Clinical assessment was conducted to evaluate two sensitive features in women with PCOS. The first was the degree of hirsutism; a professional nurse investigator assessed hair growth grades in nine key anatomic areas (Ferriman and Gallwey, 1961). The degree of hair growth for each area was scored on a scale of 0 to 4, where 0 indicates no hair growth and 4 represents the maximum grade of hirsutism. A participant's total score was obtained by combining the scores of the nine anatomic areas. The maximum possible score was 36 and a score of ≥8 indicates androgen excess. The second clinical feature was the assessment of acne. This was performed according to the Global Acne Grading Scale (GAGS) (Doshi et al., 1997). This assessment requires good lighting and is conducted on six body areas, including the face, chest, and upper back. The severity in each of the six areas is graded from 0 to 4, this is then multiplied by the factor of each area. The global score is obtained by combining all the local scores. The cut-off points of the global scores categorize the intensity of acne lesions into not active, mildly active, moderately active, active, and very active, with values of zero, 1–18, 19–30, 31–38, and >39, respectively. For the last outcome, 21 questions were used to assess the HBM constructs. The question distribution was as follows: perceived susceptibility (4 questions), perceived severity (5 questions), perceived benefit (3 questions), perceived barrier (4 questions), self-efficacy (2 questions), cues to action (3 questions). A five-point Likert scale was used to measure the scores in all questions of HBM constructs. These ranged from strongly disagree (score = 1) to strongly agree (score = 5). The average score was calculated for each question. The Internal consistency for HBM constructs was measured using Cronbach's alpha coefficient and ranged from 0.76 to 0.91.

Procedures

Following the randomization of participants into the intervention group and control group, each group followed the appropriate study procedure. The gynecologists provided control group participants with routine healthcare and advice without any educational program. Meanwhile, as well as routine healthcare and advice, the intervention group received educational sessions that prompted dietary and lifestyle modifications based on HBM. Professional researchers in the fields of gynecology, nursing science, nutrition science, and psychology developed the material. Six educational sessions were provided to the intervention group – as presented in Scheme 3. Each session included two hours of speech, questions and answers, posters and PowerPoint displays, and group discussion. The

details of the training sessions are presented in Scheme 3. As a follow-up to the intervention group activities, participants attended monthly educational sessions immediately after the intervention. Three months later, all variables of the study instruments among the intervention and control group were re-assessed. The assessment included HBM construct scores, and the value of anthropometric measurements and clinical features.



Scheme 2. Flow diagram of study population enrollment

Statistical analysis

For statistical analysis, the statistical package (SPSS; version 25, IBM, NY) was used. Paired *t*-test was used to discover the differences in the mean scores for health belief model constructs at the baseline and after three months of intervention. Independent sample *t*-test was used to find the differences in the mean scores for health belief model constructs between the intervention and control group at the baseline and after three months of intervention. Paired *t*-test was used to discover the differences in the mean scores for anthropometric and clinical variables at the baseline and after three months of intervention. Independent sample *t*-test was used to find the differences in the mean scores for anthropometric and clinical variables between study groups before (baseline) and after the intervention. The level of significance was set to a value of $p < 0.05$.

Session 1: Introduction to PCOS; its diagnosis, symptoms, and complications.

Session 2: 34-years-old female with PCOS was invited as a model and briefly talked about PCOS and its symptoms and complications.

Session 3: The role of nutrition in preventing PCOS, benefits and barriers of diet, following dietary recommendations, self-efficacy in observing proper diet, and recording activities in the specified forms.

Session 4: The benefits of weight loss for patients with PCOS and the key role of physical activity; its benefits, barriers types, and self-efficacy, and recording the duration of exercise.

Session 5: Nutritional behavior preventing PCOS. The importance of low-glycemic load diet, high fiber foods, vitamin D, selenium and iodine for PCOS patients.

Session 6: This session was conducted in the presence of two family members, and their role in providing suitable food and exercise programs was explained.

Scheme 3. Intervention education sessions, based on the health belief model

Results

The mean age of the intervention group was 28.50 ± 4.32 years, while the mean age of the control group was 28.87 ± 4.41 years ($p = 0.475$). The results in Table 1 show that the mean values for all of the HBM constructs were not significantly different between the intervention group and control group (at the study baseline) However, when compared to the control group, after three months of intervention the intervention group showed a significant increase for all constructs of HBM except perceived barriers ($p < 0.001$). The results indicated that in the intervention group there was an enhancement in the outcomes of each construct of the health belief model. Meanwhile, no significant differences were seen among the control group (where participants didn't receive any HBM-based educational training). After three months of education sessions and follow up sessions, there was a significant increase among the intervention group in the mean values of perceived susceptibility (from 8.33 ± 2.44 to 17.77 ± 2.21), perceived severity (from 10.62 ± 1.87 to 22.51 ± 2.11), perceived benefits (from 6.37 ± 1.60 to 13.12 ± 2.12), self-efficacy (from 3.75 ± 1.12 to 7.96 ± 1.07), and cues to action (from 4.82 ± 1.61 to 9.32 ± 1.98), with $p < 0.001$ for all constructs. In addition, the findings highlighted the significant role of HBM-based educational sessions in reducing the mean value of perceived barriers ($p < 0.001$).

Table 1. Scores of the HBM constructs before (baseline) and after the intervention

Constructs	Group	Baseline Mean ± SD	After 3 months Mean ± SD	Paired *t*-test
Perceived susceptibility	Intervention	8.33 ± 2.44	17.77 ± 2.21	<0.001
	Control	8.76 ± 1.93	8.9 ± 1.88	0.165
	Independent *t*-test	0.192	<0.001	
Perceived severity	Intervention	10.62 ± 1.87	22.51 ± 2.11	<0.001
	Control	10.56 ± 2.31	10.73 ± 2.19	0.231
	Independent *t*-test	0.119	0.001	
Perceived benefits	Intervention	6.37 ± 1.60	13.12 ± 2.12	<0.001
	Control	6.65 ± 1.82	6.83 ± 1.73	0.134
	Independent *t*-test	0.543	<0.001	
Perceived barriers	Intervention	16.81 ± 2.14	8.12 ± 2.28	<0.001
	Control	16.57 ± 1.56	16.63 ± 2.06	0.344
	Independent *t*-test	0.145	<0.001	
Self-efficacy	Intervention	3.75 ± 1.12	7.96 ± 1.07	<0.001
	Control	3.81 ± 1.23	3.88 ±1 .29	0.448
	Independent *t*-test	0.694	<0.001	
Cues to action	Intervention	4.82 ± 1.61	9.32 ± 1.98	<0.001
	Control	4.67 ± 1.72	4.84 ± 1.83	
	Independent *t*-test		<0.001	

The results (in Table 2) indicate that the mean values for anthropometric measurements (including BMI and WC) and clinical features (including hirsutism score and degree of acne) were not significantly different between the intervention group and control group at the study baseline. After three months of intervention, the comparison of the two groups in terms of the mean score of anthropometric measurements and clinical features showed a significant decrease among the intervention group ($p < 0.001$). Participants in the intervention group showed a significant decrease in the mean score of anthropometric measurements and clinical features after three months of intervention compared to the study baseline ($p < 0.001$). Meanwhile, there was no significant difference among participants in the control group regarding the mean score of anthropometric measurements and clinical features after three months of intervention compared to the study baseline. The reductions in the mean value of BMI and WC were from 27.66 ± 2.78 to 25.18 ± 1.87 and from 87.24 ± 7.81 to 82.46 ± 6.42, respectively. In addition, the reductions in the mean value of hirsutism and severity of acne were from 17.74 ± 4.83 to 12.65 ± 2.14 and from 20.77 ± 5.82 to 12.67 ± 4.63, respectively.

Table 2. Value of anthropometric measurements and clinical features before (baseline) and after intervention

Variables	Group	Baseline Mean ± SD	After 3 months Mean ± SD	Paired *t*-test
Anthropometric measurements				
BMI (kg/m^2)	Intervention	27.66 ± 2.78	25.18 ± 1.87	<0.001
	Control	27.15 ± 2.55	27.38 ± 2.86	
	Independent *t*-test	0.527	<0.001	
WC (cm)	Intervention	87.24 ± 7.81	82.46 ± 6.42	<0.001
	Control	88.68 ± 7.34	87.98 ± 7.52	
	Independent *t*-test	0.378	<0.001	
Clinical features				
Hirsutism score	Intervention	17.74 ± 4.83	12.65 ± 2.14	<0.001
	Control	17.84 ± 5.08	17.63 ± 2.06	
	Independent *t*-test	0.622	<0.001	
Degree of acne	Intervention	20.77 ± 5.82	12.67 ± 4.63	<0.001
	Control	20.81 ± 5.93	20.86 ± 5.77	
	Independent *t*-test	0.448	<0.001	

Discussion

PCOS is the most common endocrine disorder affecting women from adolescence through to menopause. It is highly associated with a range of reproductive, anthropometric, and dermatological problems (Gainder and Sharma, 2019). Our study results reveal the crucial role of HBM-based nutrition education in improving nutritional knowledge and enhancing dietary practices of PCOS patients. It may be the first study to explore the role of HBM-based nutrition education intervention among patients with PCOS; no previous studies were documented regarding the direct relationship between HBM-based nutrition education intervention and PCOS. The increase of nutritional knowledge among PCOS patients after the intervention might be explained by in-depth understanding of training sessions and the intensive follow-up of the participants during the intervention period. It could also be due to the higher impact of HBM in emphasizing increased awareness about the perceived susceptibility, severity of inappropriate dietary patterns and practices, and perceived benefits of following recommended dietary guidelines and recommendations for PCOS (Diddana et al., 2018).

The impact of nutrition education based on HBM have been investigated for many health-related disorders. For example, Ghaffari et al. (2012) reported the significant role of HBM-based nutritional education in enhancing osteoporosis preventive nutritional behaviors among schoolgirls. Saffari et al. (2020) documented significant improvements in all components of the lipid profile, and reductions in blood glucose and blood pressure among police officers who received an educational program based on HBM. Meanwhile, Kishk et al. (2023) indicated that implementing an HBM-based educational program led to an improvement in knowledge regarding Vitamin D deficiency (VD) and Vitamin D deficiency (VDD) among female employees – and this positively affected their VDD-preventive behaviors. Sharifirad et al. (2013) reported that 77.78% participants in the intervention group gained the recommended weight (according to BMI), but only 39.25% of the control group reached this weight – study participants were pregnant women in Gonabad who received an educational program based on HBM.

The results of this study revealed a positive outcome of HBM-based nutrition education in improving both anthropometric measurements and clinical features among PCOS patients. Regarding anthropometric measurements, the findings showed a significant improvement for BMI ad WC after the intervention. These two parameters are crucial for PCOS patients (Zhu et al., 2024). In fact, there is a significant relationship between symptoms of depression and higher values of BMI among PCOS patients (Cooney et al., 2017; Veltman-Verhulst et al., 2012). In a recent study conducted by Łagowska et al. (2024), it was reported that overweight and obese PCOS patients have a roughly six-times greater chance of depression than PCOS patients with normal body weight. The improvement in BMI and WC in our study after the intervention aligns with two previous systematic reviews. The first revealed a significant reduction in BMI due to following dietary modifications (Abdolahian et al., 2020). The second reported that interventions based on aerobic exercise were significantly associated with a decrease in WC and BMI (Kite et al., 2019). Both systematic reviews emphasized the important role of diet and exercise for PCOS patients and were discussed with our participants during the education sessions.

Regarding clinical features, this study showed that PCOS patients who received HBM-based nutrition education saw an improvement in the degree of hirsutism and acne scores. These indictors are crucial and highly affect the psychological health of PCOS patients (Archer and Chang, 2004). The current study was one of few studies to examine the effectiveness of these HBM-based intervention programs. The improvements in the measurements of the clinical features emphasized the crucial role of HBM-based health education in enhancing preventive nutrition behaviors and dietary habits among the intervention group. In their narrative review, Alomran and Estrella (2023) indicated that the dietary habits of women with PCOS are characterized by the consumption of processed foods, high carbohydrate intake, animal proteins, and high fat diets. Actually, the promoting of preventive nutritional behaviors among PCOS patients emphasized the positive impact of HMB-based

nutrition education. Considering HBM constructs, the promoting of preventive nutritional behaviors was associated with a significant increase for all constructs of HBM except perceived barriers.

Conclusion

Our results show that HBM can be implemented as a valuable tool in targeted interventions throughout nutrition-education programs. The results showed the need to use educational interventions designed to enhance the adoption of PCOS preventive nutritional behaviors. It also indicated that HBM-based nutrition education had significant effectiveness in reducing BMI, WC, hirsutism, and degree of acne scores. Healthcare professionals are highly recommended to conduct further studies to explore other outcomes of HBM-based nutrition education, including biochemical and dietary assessments. In addition, we recommend involving such models in designing frameworks for advanced health interventions among women with PCOS.

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Ethical aspects and conflict of interest
The author has no conflict of interest to declare.

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