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The Effect of Nutritional Education Based on Health Belief Model Constructs on the Nutritional Behaviors of Pregnant Afghan Immigrant Women: A Randomized Clinical Trial

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ABSTRACT

Background & aim: Pregnant Afghan immigrant women are a vulnerable population that often experience food insecurity. The Health Belief Model (HBM) is a recommended framework for nutrition education programs to influence health behavior. This study determined the effect of HBM-based nutritional education on the nutritional behaviors of pregnant Afghan immigrant women.

Methods: This randomized clinical trial used a pretest-posttest design with 116 eligible pregnant Afghan women, who were selected from health centers in Mashhad, Iran, in 2022. Participants were randomly assigned to an intervention (n=56) and control (n=56) group. Data were collected using a researcher-designed questionnaire based on HBM constructs and a standard nutritional behavior assessment for low-income populations. The intervention group received HBM-based nutrition education through four 45-60 minute sessions with 8-10 individuals in each group. Questionnaires were completed pre-intervention, immediately post-intervention, and one month later. Data were analyzed using Chi-square, Fisher's exact, independent t-test, Mann-Whitney, and repeated measures ANOVA/Friedman's tests in SPSS.

Results: The intervention group showed a significant improvement in the total HBM score and its constructs immediately and one-month post-intervention compared to both baseline and the control group (P<0.001). A significant increase was also observed in the nutritional behavior score of the intervention group at both follow-ups compared to the control group (P<0.001).

Conclusion: Nutrition education based on the HBM effectively improved the nutritional behaviors of pregnant Afghan immigrant women, providing a suitable and cost-effective method to enhance their nutritional status.

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Introduction

Nutrition plays a crucial role in pregnancy, significantly affecting the mother's health, the fetus's development, and the overall outcome of the pregnancy (1). A mother's nutritional status is closely linked to maternal and fetal outcomes related to fertility, childbirth, (2), and breastfeeding (3). Moreover, her nutrition significantly influences not only her health but

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also the growth and development of the fetus, the outcomes of birth, and the health of subsequent generations (4). Moreover, inadequate nutrition during pregnancy can lead to malnutrition in both the mother and the fetus (9).

Pregnancy-related malnutrition increases the risk of abortion, congenital abnormalities, low birth weight, and impaired child growth and development (5-6). Additionally, improper nutrition during this phase leads to intrauterine growth restriction, premature delivery, and conditions such as non-insulin-dependent diabetes, renal disorders, hypertension, and other cardiovascular diseases during adulthood (7-9). Furthermore, infants who have low birth weight due to insufficient intrauterine growth or premature delivery face a mortality rate that is 40 times higher compared to infants with a normal birth weight (10-11). Excessive food consumption is additionally associated with the prevalence of obesity, hypertension, diabetes, and pre-eclampsia (5, 12).

The prevalence of malnutrition within the overall population, particularly among the susceptible groups of women and children, is notably higher and is influenced by war and conflict, forced migration, food insecurity, and restricted access to humanitarian aid, which can disrupt nutrition and further exacerbate poor health outcomes. Migration is a significant determinant that influences various aspects of health, including nutrition, food consumption, and nutritional behaviors (13). According to the World Health Organization (WHO) report, immigrants are more susceptible to specific diseases and malnutrition (14).

The refugee population from Afghanistan is the second largest in the world, after Syrians (15). This implies that one in every nine refugees worldwide is Afghan (16). Iran serves as a primary host nation for Afghan refugees (16), with Afghans comprising a significant majority of the registered refugee population in the country, accounting for 96%. This figure represents approximately 3% of Iran's overall population (17). In general, immigrants encounter significant obstacles in fulfilling their fundamental requirements, and failing to address these needs can leave them susceptible to food insecurity (18). Although extensive research has been conducted to assess the nutritional status of refugee and immigrant households globally, and the majority of these studies have utilized experience-oriented approaches, only a few studies, both within and outside of Iran, have examined the factors influencing the nutritional behavior of Afghan immigrants in various regions of Iran (19). In Pakrovan's (2020) study, an assessment was conducted on the detrimental dietary habits and the socio-economic factors influencing them among Afghan immigrants residing in Tehran and Mashhad, and the results revealed that a significant proportion, ranging from 60% to 77%, experienced varying degrees of food insecurity, ranging from moderate to severe (19). Women often face the challenge of food insecurity as they bear the responsibility of managing the nourishment of their family members (18).

The educational attainment and literacy levels of Afghan immigrant women exhibit an inverse correlation with their vulnerability to unfavorable nutritional status and food insecurity. The education and training of women seem to positively influence their capacity to effectively manage household nutrition, thereby minimizing the likelihood of unfavorable nutritional behaviors and food insecurity (18). Health education is widely acknowledged as a highly effective intervention technique for modifying health behaviors and ultimately enhancing and maintaining health (20). Pregnancy presents a favorable occasion to educate expecting mothers, intending to raise their awareness about the advantages of maintaining a nutritious diet and adopting a healthy lifestyle (21).

By incorporating behavior change models and theories, health education programs can be made more effective by considering the influence of individual and environmental characteristics on behaviors (22). Health behavior educators play a crucial role in providing active guidance by incorporating theories and models. Notably, the health belief model (HBM) has proven to be one of the effective methods for promoting health behavior change interventions (23-24).

The HBM aims to modify individuals' awareness, attitudes, and behaviors and has been employed in numerous research endeavors on health-related behaviors (3, 20). This individual model of health behaviour, with roots in behavioral science theories, has been applied in educational settings across different fields (2). HBM presents a notable advantage by incorporating structures that account for significant dimensions determining behavior, such as perceived sensitivity, perceived intensity, perceived benefits, perceived obstacles, indications for action, and self-efficacy. This model is built upon the fundamental principle that people are driven to act, and it underscores the importance of individual beliefs[1] concerning the fear of health problems. Moreover, it highlights the evaluation of the advantages and challenges associated with specific behaviors, which catalyzes embracing the correct behavior (10, 25). The HBM has been suggested as one of the models utilized in nutrition education programs (26, 27).

Ziaei et al.'s (2016) study findings indicate that an educational intervention based on HBM significantly enhanced the nutritional behaviors of pregnant mothers in the experimental group. In this investigation, the identification of enhanced sensitivity structures and the perceived intensity of predictive factors in appropriate health measures were determined (20). Khorramabadi et al. (2016) conducted a study that found no significant distinction in the scores of HBM structures between the experimental and control groups after the intervention, except for the perceived sensitivity structure. However, it is worth noting that the score of nutritional behaviors of women in the intervention group increased after the educational intervention (26). The outcome of this study contradicts the conclusion drawn by Karimi et al. (2016), who reported the dominant role of perceived barriers in predicting and expressing nutritional behaviors for health protection (10). On the one hand, the constructs of the Health Belief Model can play an important role in educating pregnant mothers on appropriate nutritional behaviors. However, their effectiveness can vary, leading to different outcomes in promoting healthy nutritional practices during pregnancy. On the other hand, ensuring proper nutrition for pregnant women is socially important, especially considering the challenges posed by food insecurity among Afghan immigrant pregnant women. Therefore, this study aimed to examine the influence of the Health Belief Model constructs on the nutritional behaviors of pregnant Afghan immigrant women residing in Mashhad.

Materials and Methods

The present study was a randomized clinical trial with a pretest-posttest design, conducted in 2022 after obtaining ethical approval (IRCT code) and official permissions from Mashhad University of Medical Sciences. The study was conducted at Health Center Number Two in Mashhad City, which serves as the primary healthcare facility for a large Afghan immigrant population. Four health centers under its coverage were randomly selected using a lottery method, with two allocated to the intervention group and two to the control group. From these centers, eligible pregnant Afghan women with pregnancy records were systematically sampled from covered individual's lists. Participants were then assigned to intervention or control groups using a random number table. The researcher contacted the selected women, explained the study objectives and procedures, and obtained written informed consent from those who met the inclusion criteria.

The study necessitated a sample size of 44 individuals in each group, considering an error level of 0.05 and a test power of 80%. This estimation was made using a formula, assuming a 15% drop in the final sample volume of 58 individuals in each group. The inclusion criteria were Afghan immigrant pregnant women with a singleton pregnancy at gestational age of less than 20 weeks based on a first-trimester pregnancy ultrasound, consent to participate in the study, being healthy, having a desired pregnancy, being over 18 years old and literate, having a contact number, not participating in any other research concurrently, and not having any disease that necessitates intervention for the mother or fetus, not having any chronic systemic disease, not adhering to a specific diet, not experiencing severe emotional and mental problems in the mother, and not being addicted to smoking or drugs. The exclusion criteria included individuals who expressed a lack of interest in continuing the research, those who did not attend more than one training session, those who failed to respond to more than 10% of the questionnaire questions, and mothers who experienced severe emotional and mental issues during the research. Despite the inclusion of 58 individuals in each group, two individuals from the intervention group had to be excluded due to relocation, a diagnosis of a blighted ovum (anembryonic pregnancy), while two individuals from the control group experienced miscarriage. Consequently, the analysis was conducted with a total of 112 participants (Figure 1).

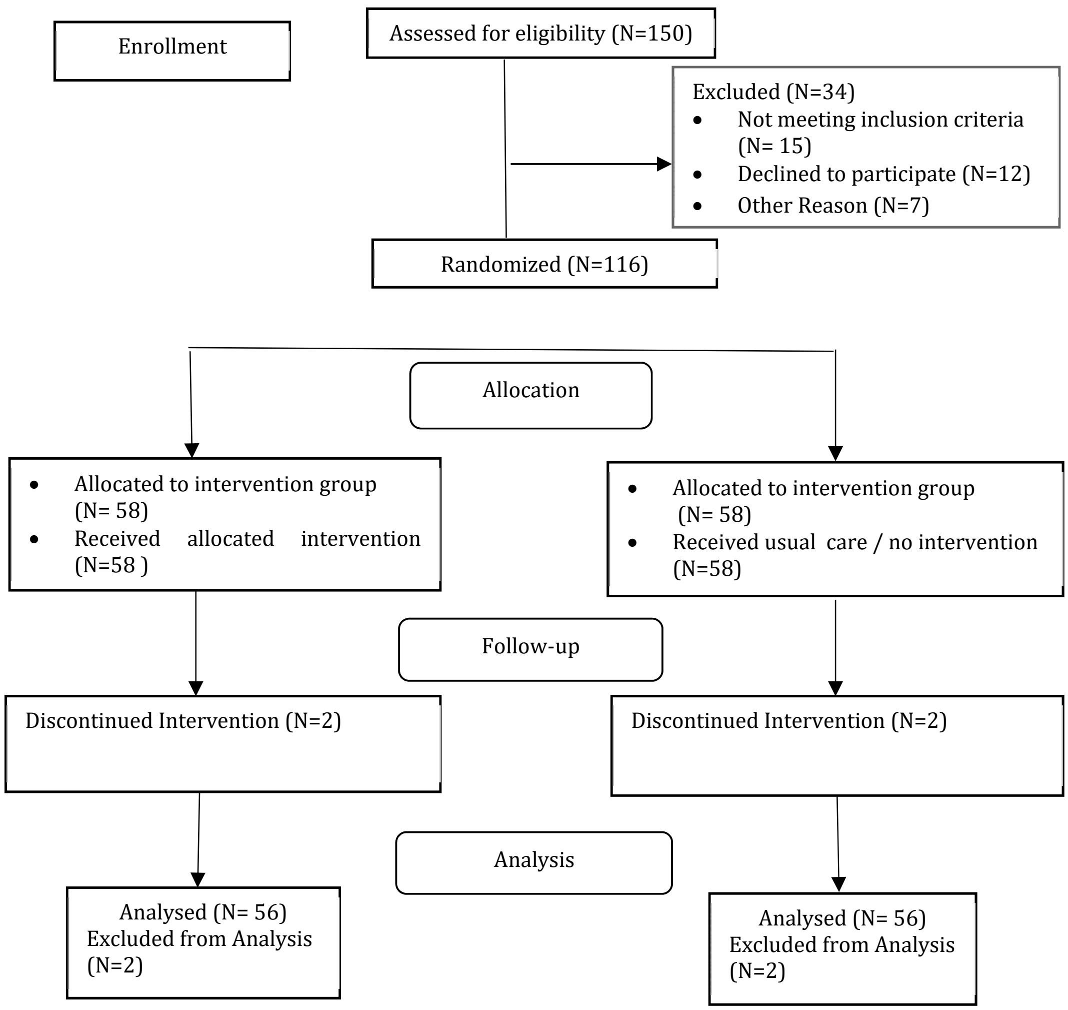

Figure 1. CONSORT Flowchart of the study

The data collection tools comprised a demographic information questionnaire, a researcher-made questionnaire based on the constructs of the health belief model, and a specialized questionnaire on nutritional behavior designed for low-income populations. Various demographic information, such as age, education, occupation, marital status, spouse's education, spouse's occupation, family income, housing status, weight, height, body mass index, gestational age, the number of pregnancies, abortion history, stillbirth history, and pregnancy complications in the current pregnancy, were recorded and evaluated in the relevant form. In line with the HBM model, the researcher developed a questionnaire consisting of 40 questions. Each question was meticulously designed to evaluate the different aspects of perceived sensitivity, perceived intensity, perceived benefits, and self-efficacy. Furthermore, the cues to action were assessed using eight questions with a scoring range of 8 to 40 and four questions with a range of 4 to 20. To respond to the related questions concerning these constructs, a five-point Likert scale (from completely to completely disagree) was utilized. The questionnaire for low-income individuals, which was previously developed and validated in earlier studies, consists of 48 questions divided into eight sections, including 1) Consuming different food groups such as fruits, vegetables, dairy products, calcium sources, grains, meat, unhealthy snacks, and salt, 2) Nutritional Behaviors and Cooking, 3) Food purchasing behavior, 4) Attitude, 5) Access to Food, 6) Weight Control, and 7) Physical Activity. The questionnaire included 48 items across eight sections. The first 17 questions assessed the consumption of different food groups with four-choice answers (daily, weekly, never, or skip). Ten questions addressed eating behaviors and cooking methods using a combination of four- and six-point Likert scales. Two questions evaluated food purchasing behaviors on a six-point Likert scale. Five items measured attitudes toward nutritional behavior with a four-point Likert scale. Eight questions on food availability used a six-point Likert scale. Three questions assessed weight-control practices, two with four-point Likert scales and one including 13 specific weight-control actions in the past 12 months. Finally, two questions evaluated physical activity: one with a four-point Likert scale and one asking for the number of hours or minutes of activity (28). To ensure the form and content validity of the researcher's developed tool, a questionnaire was meticulously crafted following extensive library studies and in collaboration with eight esteemed faculty members from Mashhad University of Medical Sciences. The content validity index and ratio were computed, and the content validity ratio values for the construct questions were determined to be 0.79. Cronbach's alpha of 0.87 validated the questionnaire's reliability. Furthermore, infrastructural consistency was confirmed (perceived sensitivity structure 0.77, perceived intensity structure 0.78, perceived benefits structure 0.76, perceived barrier structure 0.70, self-efficacy constructs 0.81, and guiding construct for action 0.71). To validate the nutritional behavior questionnaire for low-income populations in Afghanistan, qualitative and quantitative content validity (CVR, CVI determination) was employed. This validation process had not been conducted previously. As per Lawshe's table, a minimum acceptable value of 0.99 for CVR was required for seven individuals, and the CVI index has been set at a minimum acceptable value of 0.7. Questions with a score of 0.7-0.78 were evaluated and modified, while items with a score of 0.79 or higher were retained.

Initially, the research units conducted the pre-test by completing demographic and researcher information questionnaires designed according to the framework of the HBM model. The researcher implemented an educational intervention including nutrition instruction based on the HBM model's structures. This intervention was conducted in groups of 8-10 people for four 45–60-minute sessions. The initial educational program session primarily emphasized enhancing nutrition awareness and knowledge. The second session was based on the concepts of perceived sensitivity and perceived intensity. The third session focused on the constructs of perceived benefits and perceived obstacles, and the fourth session aimed to explore self-efficacy structures and offer action guidelines. Following the intervention, the research units promptly completed the instruments in the post-test stage, both immediately after and one month later. During the research, the control group received routine services according to the standard program. Educational pamphlets were provided to them after the completion of the study.

The statistical analyses were conducted using SPSS version 21, with a significance level set at

0.05. The data were subsequently characterized using suitable measures of central tendency and variability. Additionally, the Chi-square test was used to evaluate the distribution of demographic and clinical qualitative variables among the study groups (or Fisher's exact test if necessary). To assess the distribution of quantitative demographic and clinical variables in the study groups, independent t-tests or Mann-Whitney tests were utilized, considering the normality of these variables. The normality of the data was assessed using Shapiro-Wilk tests with a significance level of 0.05. To analyze changes in nutritional behavior and scores in the research groups, the repeated measures test (for normal distribution of the nutritional behavior variable) or Friedman's test (for non-normal distribution of the nutritional behavior variable) was used. Blinding was not possible due to the nature of the intervention; both participants and the researcher delivering the educational sessions were aware of group assignments. The questionnaires were completed by the participants themselves under the supervision of the researcher, who also conducted the educational sessions and performed the data entry and statistical analyses.

Results

Demographic characteristics: The average age of the mothers analyzed was 29.92± 15.6 years. The majority (46%) had completed middle and high school. The majority of study subjects were housewives, accounting for 90% of the participants. Among the mothers, 97% identified as Shia, while 80% were of the Hazara ethnicity. The majority of the participants interviewed resided in rented accommodation. The average household income was 4.5±3.47 million Tomans. The analysis of Chi-square and Fisher's exact tests revealed no significant difference in age, education, spouse's education, occupation, religion, ethnicity, housing status, length of residence in Iran, and income between the two groups. Furthermore, the two groups were homogeneous concerning these characteristics (P≤0/05). The Pearson chi-square test's results indicated that the wife's occupation variable was the only heterogeneous variable observed between the groups of study (p:0/042).

In the study, it was found that the highest number of deliveries reported by the subjects was 7 cases. Similarly, the maximum number of pregnancies observed among the participants was 8 cases. Furthermore, the study indicated that 7 cases represented the highest number of live children born to the subjects. The youngest child had an average age of 2.5±3.31 years, as determined by the study. Additionally, it was found that 41% of the individuals included in the research had a body mass index within the normal range. The majority of individuals examined had no prior experience of abortion or stillbirth, and the majority reported being in good health. Based on the findings from the Mann-Whitney, Fisher's exact, and Chi-Square Pearson tests, it was determined that the age of the youngest child was the only variable that exhibited heterogeneity among the clinical and obstetric characteristics in both study groups. Notably, the Mann-Whitney test revealed a significant difference (P=0.048) between the two groups in terms of this particular variable According to the Mann-Whitney test results, which is based on the constructs of the HBM model, there was a significant increase in the total score of the researcher's questionnaire for the intervention group, both immediately and one month after the intervention, compared to before the intervention (P<0.001). The intra-group comparison using Friedman's test showed a significant difference (P<0.001) in the intervention group stages. Based on the findings from the analysis of variance with repeated measures, it was determined that there was no significant statistical distinction observed among the stages in the control group (P=0.454) (Table 1).

Perceived sensitivity**:** The perceived sensitivity total score exhibited a significant increase (P<0.001) immediately and one month after the intervention in the intervention group, as compared to before the intervention. According to the intra-group comparison, the Friedman test revealed a significant difference in the perceived sensitivity structure score between stages within the intervention group (P<0.001) (Table 2).

Table 1. Comparison of intra-group and inter-group changes in the total score of the HBM questionnaire

Variable	Control group SD ± Mean	Intervention group SD ± Mean	Intergroup Test Results
Pre-intervention score	74/02 ± 6/54	71.34 ± 6.67	t= -2.183* P= 0.031
Score immediately after the intervention	73/86 ± 6/83	83.71 ± 6.62	t= 7.741* P< 0.001
Score one month after the intervention	73/65 ± 7/20	84.57 ± 6.95	t= -6.428* P< 0.001
Score changes immediately after the intervention compared to before the intervention	-0/45 ±5/61	12.12 ±8.26	Z= -7.774** P< 0/001
Score changes one month after the intervention compared to before the intervention	-0/70 ±5/81	12.98 ± 8.65	Z= -7.942** P< 0.001
The results of the intragroup test	F= 0.659*** P= 0.454	F= 89.358**** P< 0.001	

* Independent samples t-test ** Mann-Whitney test *** Repeated measures ANOVA **** Friedman test

Perceived intensity: The two groups did not exhibit any significant variation in the mean and standard deviation of the total score for the perceived intensity before the intervention (P=0.208). Following the intervention, there was a notable distinction (P<0.001) in the mean and standard deviation of the total score of perceived intensity between the intervention group and the control group. A significant difference was detected in the mean and standard deviation of the perceived intensity structure score one month after the intervention between the intervention group and the control group (P<0.001). Following the intervention, there was a noteworthy rise in the total score of the perceived intensity structure in the intervention group, both immediately and one month later, compared to the pre-intervention period (P<0.001). Significant differences were observed in the perceived intensity structure scores between stages within the intervention group (P<0.001), whereas no significant difference was found in the control group (P=0.882) (Table 2).

Perceived benefits: There was no significant difference in the mean and standard deviation of the total score for the perceived benefits between the two groups before the intervention (P=0.134). Meanwhile, a notable distinction was observed immediately after the intervention (P=0.003) and one month later (P=0.003) between the two groups. Furthermore, the intervention group experienced a substantial rise in the overall score of this particular structure immediately and one month after the intervention, in contrast to the period before the intervention. This increase was found to be statistically significant (P<0.001). In the intra-group comparison, a significant variation was observed in the perceived benefits structure score between the stages within the intervention group (P<0.001). Conversely, this variation did not reach statistical significance in the control group (P=0.961) (Table 2).

Perceived barrier: No statistically significant dissimilarity was observed in the mean and standard deviation of the total score of perceived barriers between the intervention and control groups before the intervention (P=0.365). Immediately after the intervention, there was a significant difference in the mean and standard deviation of the total score of perceived barriers in the intervention group and the control group (P<0.001). A significant difference was observed between the intervention group and the control group in the mean and standard deviation of the total score of the perceived barrier structure immediately and one month after the intervention (P<0.001). The perceived barrier structure score in the intervention group revealed a significant difference between stages (P<0.001) in the intra-group comparison. However, in the control group, any difference between stages was not deemed significant (P=0.625) (Table 2).

Table 2. Comparison of intra-group and inter-group changes in health belief model constructs' score

Variable	control group SD ± Mean	Intervention group SD ± Mean	Intergroup Test Results
Perceived sensitivity			
Score changes immediately after the intervention compared to before the intervention	-2.14±12.88	11.68±11.35	Z=-5.368* P< 0.001
Score changes one month after the intervention compared to before the intervention	-1.40 ± 12.77	13.06±12	Z=-5.577* P< 0.001
The results of the intragroup test	F= 0** P= 1	F= 49.926** P< 0.001	
Perceived intensity			
Score changes immediately after the intervention compared to before the intervention	- 0.28 ± 12.46	12.21 ± 13.24	Z= -4.811* P < 0.001
Score changes one month after the intervention compared to before the intervention	-0.27 ± 12.48	13.25 ± 14.36	Z= -4.791* P < 0.001
The results of the intragroup test	F= 0.250** P= 0.882	F= 66.780** P < 0.001	
Perceived benefits			
Score changes immediately after the intervention compared to before the intervention	-0.71 ±9.92	8.66±13.43	Z=-3.759* P < 0.001
Score changes one month after the intervention compared to before the intervention	-0.61 ±9.7	10.78 ± 14.39	Z=-3.877* P < 0.001
The results of the intragroup test	F= 0.80** P= 0.961	F= 25.043** P < 0.001	
Perceived barrier			
Score changes immediately after the intervention compared to before the intervention	0.56 ± 8.48	14.23 ±15.27	Z= -5.313 P < 0.001*
Score changes one month after the intervention compared to before the intervention	0.56 ± 8.52	14.16 ± 14.26	Z= -5.205 P < 0.001*
The results of the intragroup test	F= 0.941 P= 0.625**	F= 48.6 P < 0.001***	
Self-efficacy			
Score changes immediately after the intervention compared to before the intervention	0 ±8.45	14.24 ±14.65	Z= -5.747* P < 0.001
Score changes one month after the intervention compared to before the intervention	-1.37 ± 8.66	16.15 ± 15.38	Z= -6.301* P < 0.001
The results of the intragroup test	F= 2.552** P= 0.279	F= 52.198** P < 0.001	
Cues to action			
Score changes immediately after the intervention compared to before the intervention	0.62 ± 10.66	9.95 ± 10.93	Z= -4.113* P < 0.001
Score changes one month after the intervention compared to before the intervention	0.54 ± 10.30	10.89 ± 11.69	Z= -4.710* P < 0.001
The results of the intragroup test	F= 0.206*** P= 0.740	F= 39.17*** p <0.001	

* Mann-Whitney test   ** Friedman test   *** Repeated measures ANOVA

Self-efficacy: The statistical analysis revealed no significant difference in the mean and standard deviation of the total score of the self-efficacy structure before the intervention between the intervention and control groups (P=0.224). The score indicated a significant difference both immediately and after one month from the intervention in the two groups (P<0.001). When analyzing the changes in the total score of the self-efficacy structure at different stages, the intervention group showed significant differences in the changes immediately and one month after the intervention compared to before the intervention (P<0.001). In the comparison within the group, the self-efficacy construct score revealed a significant difference between stages in the intervention group (P<0.001). However, in the control group, this difference between stages was not found to be significant (P=0.279) (Table 2).

Cues to action: The mean and standard deviation of the total score of the cues to action before the intervention did not show any significant difference between the two groups (P=0.681). However, the intervention group and the control group exhibited a significant difference in the mean and standard deviation of the total score of this structure both immediately and one month after the intervention (P<0.001). A substantial difference was observed in the total score of the guide structure for the operation when comparing the assessments immediately and one month after the intervention to the pre-intervention evaluation in the two groups (P<0.001). Significant differences were observed in the scores for action stages within the intervention group (P<0.001), whereas no significant difference was found in the control group (P=0.740) (Table 2).

Following the intervention, the intervention group exhibited a significant increase in their total nutritional behavior score by 15.14 ± 8.02, whereas the control group only experienced a slight increase of 0.49 ± 5.93. The difference between the two groups was statistically significant (P<0.001) according to the Mann-Whitney test. The intervention group exhibited a noteworthy increase of 15.67 ± 8.45 in their total score of nutritional behavior one month after the intervention compared to before the intervention. Conversely, the control group experienced a decrease of 1.7 ± 6.14 in their total score. The Mann-Whitney test confirmed the statistical significance of this difference (P<0.001). In the intra-group comparison, the repeated measures analysis of variance revealed a significant difference (P<0.001) between stages in the intervention group, while the difference between the stages in the control group indicated a significant decrease (P=0.022) (Table 3).

Table 3. Comparison of intra-group and inter-group changes of the total nutritional behavior score

Variable	Control group SD ± Mean	Intervention group SD ± Mean	Intergroup Test Results
Pre-intervention score	62.14 ± 8.43	57.39 ± 8.49	t= -2.95* P= 0.004
Score immediately after the intervention	62.98± 8.36	72.62 ± 6.31	t=6.79* P < 0.001
Score one month after the intervention	60.91 ± 7.79	73.34 ± 6.66	t=8.95* P < 0.001
Score changes immediately after the intervention compared to before the intervention	0.49± 5.93	15.14± 8.02	Z= -7.6** p<0.001
Score changes one month after the intervention compared to before the intervention	-1.7±6.14	15.67±8.45	Z =-8.12** P < 0.001
The results of the intragroup test	F= 3.9*** P= 0.022	F= 168.55*** p<0.001	

* Independent samples t-test ** Mann-Whitney test *** Repeated measures ANOVA

The GEE (Generalized Estimating Equation) model was employed to compare the impact of the intervention on the nutritional behavior score, taking into account the non-uniform distribution of variables such as the age of the youngest child and the spouse's occupation in the two study groups, which allowed for the adjustment of these variables and the scores before the intervention to investigate the effect of the intervention on changes in structures and heterogeneous variables associated with nutritional behavior. Based on the results of this model, the intervention had a significant effect on the total score of nutritional behavior. It should be noted that according to the obtained results, there is an interaction between time and the study group (P=0.003).

The GEE model suggests that the modifications in the constructs of perceived benefits and perceived barriers exerted the most notable influence on the variations witnessed in the total nutritional behavior score (Table 4).

Table 4. GEE model processing to investigate the effect of intervention, structural changes, and heterogeneous variables in two groups on nutritional behavior changes

Variable	The regression coefficient	Confidence Interval 95%	P-Value
Group			
Control (reference)	-	-	-
Intervention	12.43	(-9.32_15.54)	< 0.001
Aage of the youngest child	-0.172	(0.473_0.13)	0.265
Spouse occupation			
Freelance job			
manual worker	1.139	(-1.52_3.8)	0.402
Other	-2.35	(-5.72_1.02)	0.172
Time			
Immediately after the intervention compared to before the intervention (reference)	-	-	-
One month after the intervention compared to before the intervention	2.203	(0.773_3.63)	0.003
Perceived sensitivity	0.02	(-0.063_0.103)	0.633
Perceived intensity		(-0.124_0.108)	0.889
Perceived benefits	0.236	(-0.125_0.346)	<0.001
Perceived barrier	0.242	(0.137_0.347)	<0.001
Self-efficacy	-0.081	(-0.185_0.022)	0.124
cues to action	0.044	(-0.080_0.167)	0.488
Time	-2.703	(-4.466_0.94)	0.003

Dimensions of nutritional behavior questionnaire in low-income populations:

It is norable that apart from analyzing the overall score of the nutritional behavior questionnaire in low-income communities, which was investigated as the primary outcome, the various dimensions of this questionnaire were also measured (Table 5).

Table 5. Comparison of intra-group and inter-group changes in nutritional behavior dimensions

Variable	Control group SD ± Mean	Intervention group SD ± Mean	Intergroup Test Results
Consumption of fruits and vegetables			
Score changes immediately after the intervention compared to before the intervention	-2.08 ± 9.29	9.37 ± 13.01	Z= -4.981 * P < 0.001
Score changes one month after the intervention compared to before the intervention	-5.3 ± 9.67	7.88 ± 11.5	Z= -5.665 * P < 0.001
The results of the intragroup test	F= 20.41** P < 0.001	F= 28.46** P < 0.001	
Consumption of milk and dairy products			
Score changes immediately after the intervention compared to before the intervention	-1.19 ± 13.841	11.5 ± 17.07	Z= -4.064* P < 0.001
Score changes one month after the intervention compared to before the intervention	-3.83 ± 14.21	10.31 ± 16.11	Z= -4.55* P < 0.001
The results of the intragroup test	F= 5.912*** P=0.052	F= 28.193*** P < 0.001	
Consuming whole grains			

Variable	Control group SD ± Mean	Intervention group SD ± Mean	Intergroup Test Results
Score changes immediately after the intervention compared to before the intervention	-4.76 ± 19.77	2.67 ± 20.29	Z=-1.851* P=0.064
Score changes one month after the intervention compared to before the intervention	-5.75 ± 17.63	1.19 ± 22.66	Z=-1.887* P=0.059
The results of the intragroup test	F = 7.119** P= 0.028	F = 0.794** P= 0.672	
Consumption of meat and legumes			
Score changes immediately after the intervention compared to before the intervention	0.09 ± 5.65	5..55 ± 9.59	Z= -3.268* P=0.001
Score changes one month after the intervention compared to before the intervention	-0.4 ± 5.64	4.66 ± 9.16	Z= -3.28* P=0.001
The results of the intragroup test	F = 0.241** P= 0.887	F = 19.5** P < 0.001	
Consuming fast foods and harmful snacks			
Score changes immediately after the intervention compared to before the intervention	0.59 ± 16.19	12.79 ± 21.78	Z=-3.154* P= 0.002
Score changes one month after the intervention compared to before the intervention	3.93 ± 18.41	15.47 ± 22.88	Z=-2.886* P=0.004
The results of the intragroup test	F = 1.48** P= 0.475	F = 23.85** P < 0.001	
Nutritional habits score			
Score changes immediately after the intervention compared to before the intervention	-2.5 ± 12.11	20.47 ± 19.1	Z= -6.48** P<0.001
Score changes one month after the intervention compared to before the intervention	-0.48 ± 14.99	19.64 ± 19.90	Z= -5.66** P<0.001
The results of the intragroup test	F= 1.49*** P= 0.229	F= 49.41** P < 0.001	

* Mann-Whitney test ** Friedman test *** Repeated measures ANOVA

Continued Table 5. Comparison of intra-group and inter-group changes in nutritional behavior dimensions

Variable	control group SD ± Mean	Intervention group SD ± Mean	Intergroup Test Results
Food purchasing behavior			
Score changes immediately after the intervention compared to before the intervention	0.89 ± 20.94	30 ± 35.63	Z= -4.983* P<0.001
Score changes one month after the intervention compared to before the intervention	0 ± 25.05	33.93 ± 33.32	Z= -5. 615* P<0.001
The results of the intragroup test	F= 0.194** P= 0.9	F= 52.97** P < 0.001	
Attitude towards healthy nutritional behavior			
Score changes immediately after the intervention compared to before the intervention	15.71 ± 30.68	18.03 ± 21.27	Z= -2.921* P= 0.003
Score changes one month after the intervention compared to before the intervention	-5.81 ± 14.74	15.71 ± 12.62	Z= -7.264* P<0.001
The results of the intragroup test	F= 20.23** P < 0.001	F= 59.53** P < 0.001	
Access to healthy food			
Score changes immediately after the intervention compared to before the intervention	-2.08 ± 12.12	13.54 ± 17.13	Z= -5.334** P<0.001

Variable	control group SD ± Mean	Intervention group SD ± Mean	Intergroup Test Results
Score changes one month after the intervention compared to before the intervention	-3.03 ± 11.09	16.66 ± 18.20	Z= -6.285** P<0.001
The results of the intragroup test	F= 2.38*** P= 0.109	F= 46.49** P < 0.001	
Weight control			
Score changes immediately after the intervention compared to before the intervention	7.16 ± 23.9	22.06 ± 23.75	Z= -4.387* P<0.001
Score changes one month after the intervention compared to before the intervention	3.25 ± 16.79	26.66 ± 22.01	Z= -6.13* P<0.001
The results of the intragroup test	F= 4.33** P=0.115	F= 62.54** P < 0.001	
Physical activity			
Score changes immediately after the intervention compared to before the intervention	-5.45 ± 29.14	23.21 ± 45.93	Z= -4.401* P<0.001
Score changes one month after the intervention compared to before the intervention	-10.18 ± 35.85	30.35 ± 36.52	Z= -5.66* P<0.001
The results of the intragroup test	F= 10.74** P= 0.005	F= 35.5** P < 0.001	

* Mann-Whitney test ** Friedman test *** Repeated measures ANOVA

Discussion

This study assessed changes in health belief model (HBM) constructs regarding dietary habits of Afghan immigrant pregnant women immediately and one month after the intervention. Overall HBM scores increased significantly in the intervention group across all constructs, including perceived sensitivity, intensity, benefits, barriers, self-efficacy, and guide-to-action, while no significant changes were observed in the control group. These findings confirm the positive impact of HBM-based nutrition education. Similar results were reported in other studies. Ziaei et al. (2015) observed significant improvements in all HBM constructs among Iranian pregnant women following education (20). Likewise, Diddana et al. (2017) found significant increases in all HBM constructs among Ethiopian pregnant women post-intervention (29), aligning with the current study outcomes. In Hasneezah's (2020) study, conducted to determine the effectiveness of an intervention based on health belief theory in improving hemoglobin levels among pregnant women with anemia in Malaysia, significant differences were observed in the intra-group scores of all constructs, except for the perceived benefits construct, which does not align with the results obtained in the present study (30). Several factors could explain this discrepancy, including differences in cultural context, dietary habits, educational methods, or sample characteristics. Furthermore, the findings of the study by Khorramabadi et al. (2016), which aimed to determine the effect of education based on the health belief model on the eating behaviors of Iranian pregnant women, revealed a significant difference in the scores of the health belief model constructs, except for perceived sensitivity. Thus, no significant difference in the score of this structure after the intervention was seen between the intervention and control groups, contradicting the findings of the current investigation (26). The lack of a significant difference in this construct in the current study may be attributed to variations in the duration of the intervention, baseline knowledge of participants, or other contextual factors specific to the study population. Numerous studies have been conducted to assess the effectiveness of nutrition education based on the health belief model, which consistently emphasizes the improvement in scores for certain constructs within the model. However, it is worth noting that not all constructs exhibit significant progress. However, the substantial increase in the score of all constructs of the health belief model in the current study improvement can be attributed to the teaching method employed and the researcher's equal emphasis on all components, encompassing the perceived advantages of adopting healthy nutritional behaviors and the perceived sensitivity towards the potential repercussions of failing to adhere to correct nutritional practices during pregnancy. Moreover, this finding can be linked to the age of the participants, as older individuals displayed a higher level of enthusiasm toward education and were more accepting of it (31). Thus, in the present study, the average age of the participants was higher compared to the research conducted by Khoramabadi and Hassaniza (26, 30).

The present study revealed a significant increase in the total nutritional behavior score among pregnant Afghan immigrant women immediately after the intervention and one month later compared to baseline. The intervention group showed a sustained improvement in nutritional behavior across all HBM constructs, while the control group exhibited only a slight increase immediately after the intervention, followed by a decline within a month. The intra-group comparison confirmed a significant difference in nutritional behavior scores across different stages in the intervention group, whereas the control group showed a notable decrease over time.

The greater improvement in the intervention group can be attributed to the educational program based on the Health Belief Model, which effectively addressed perceived barriers, enhanced self-efficacy, and provided strategies for incorporating proper nutrition into daily routines. In contrast, the control group's decline was likely influenced by common pregnancy-related issues, particularly digestive problems such as heartburn, which were not addressed through targeted education.

Socioeconomic factors also played a role in these outcomes. Limited access to affordable and nutritious food, especially protein-rich and calcium-containing options, posed a challenge for some participants in both groups. However, mothers in the intervention group were provided with practical alternatives and guidance to overcome these barriers. Additionally, the relatively low income of participants in the control group may have contributed to their lower nutritional behavior scores, highlighting the influence of economic constraints on dietary habits. This is evident as the average income of most research units was below the international poverty line established by the World Bank in 2022 (32). Individuals in the Nutrition Education Teaching Group, which adheres to a health-focused approach, effectively overcame challenges in adopting appropriate nutritional habits. Despite the expensive nature and restricted accessibility of specific nourishing foods, they successfully integrated them into their dietary routines.

The study conducted by Diddana et al. (2017) titled "The Influence of Nutrition Education on Nutrition Knowledge and Performance of Pregnant Women's Diet in Des City, Northeast Ethiopia: A Random Cluster Control Transaction" revealed that the nutritional status of pregnant women in the intervention group improved significantly compared to their counterparts even before the intervention (29). The findings of this research align with the current study. Furthermore, Ziai et al. (2017) demonstrated that implementing nutrition training grounded in a health faith model significantly improved the average nutritional behavior score (20). It has been consistent with the study's findings in this regard. Furthermore, the findings of Khorramabadi et al. (2016) align with the current study's results regarding the enhancement and advancement of food behaviors in the intervention group of women following an educational intervention based on the health faith model (26). The variation in findings between this study, the present study, and the studies conducted by Visa and Ziai can be ascribed to the absence of utilizing the model within the framework of nutritional education intervention for pregnant women. Utilizing the appropriate model within the domain of nutrition education, as a crucial aspect of health education, enhances the efficacy of training and ultimately fosters a transformation in behavior (22).

To assess the influence of intervention on nutritional behavior, the current study analyzed the data. The results indicated that among the components of the hygiene belief model, the changes in perceived interest structures and perceived barriers had the most substantial impact on the overall score of nutritional behavior changes. According to Karimi et al.

(2015), perceived barriers were the most influential predictor of nutritional behaviors in predicting nutritional behaviors. Additionally, the study revealed a substantial and favorable correlation between perceived interests and nutritional behavior (10). The findings of Quayyum et al. (2021) corroborate those of the present study, indicating a reduction in perceived barriers and a significant improvement in maternal nutritional status (32). These results are consistent with the findings of the present study. The study conducted by Sharifirad et al. (2013) aimed to compare nutrition training approaches based on the traditional nutritional education model with a health faith model for nutrition function. The study findings provided additional evidence supporting the benefits of nutrition training based on the health faith model (2). Based on this research, the case group experienced the greatest increase in the structure of perceived interests. Furthermore, this particular variable exhibited the strongest and most notable correlation with nutritional behavior, aligning perfectly with the findings of the current study. It should be noted that the findings of this study highlight the favorable association between perceived structure and nutritional choices among pregnant women. The attention given by mothers toward the significance of maintaining a healthy diet to improve the well-being of both the mother and the fetus and to minimize pregnancy-related complications can effectively contribute to the promotion of perceived interests.

Based on Khorramabadi et al. (2016), educating mothers about healthy nutrition enhances their awareness of infant health and reduces postpartum complications like bleeding and delayed recovery. The study found that educational programs effectively helped mothers overcome barriers by providing practical, affordable food alternatives for protein, calcium, and vitamins (26).

One of the strengths of the present study is that it represents one of the first investigations to examine the effect of model-based education on behavioral change among Afghan immigrant pregnant women. The research faced a limitation in the form of non-cooperation among the research units, which increased the likelihood of their potential dropout. However, efforts were made to address this challenge by providing a comprehensive explanation of the research's objectives, ensuring the confidentiality of information, and employing incentive techniques such as distributing pamphlets that detailed the content of each meeting and encouraging the participation of the research units to maintain a certain level of control over their involvement. Additionally, the study's findings were limited by the brief duration of the intervention, a constraint that was unavoidable due to the short length of pregnancy among the participants. Another limitation of the present study is that blinding was not feasible due to the nature of the educational intervention; both participants and the researcher were aware of the group assignments, which may have introduced some bias. It is suggested that, in light of the role of environmental and cultural factors in educational success, the effect of education based on the health belief model on intra-individual constructs of nutritional behavior in Afghan immigrant pregnant women and Iranian women should be studied comparatively.

The findings of this study highlight the practical value of integrating education based on the Health Belief Model into routine prenatal care for Afghan immigrant pregnant women. By addressing perceived barriers, enhancing self-efficacy, and emphasizing the benefits of proper nutrition, such interventions can help improve maternal dietary behaviors, which in turn may reduce pregnancy-related complications such as anemia, poor wound healing, and delayed recovery. Health professionals, particularly midwives, could adopt similar educational approaches as part of standard antenatal care programs to promote healthier nutritional practices among vulnerable populations.

Conclusion

The utilization of the health belief model has proven to be highly beneficial in positively influencing the nutritional behavior of pregnant Afghan immigrant women. To further enhance this population's well-being, it is recommended that managers, programmers, and international institutions involved in immigrant affairs develop comprehensive educational programs tailored to the specific needs of Afghan pregnant women, based on the Health Belief Model, thereby promoting effective nutrition among this population.

Declarations

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Conflicts of interest

The authors declared no conflicts of interest.

Ethical considerations

All procedures performed in this study were in accordance with the ethical standards of the institutional research committee and the 1964 Helsinki declaration and its later amendments. Written informed consent was obtained from all participants before enrollment.

Code of Ethics

The study was approved by the Ethics Committee of Mashhad University of Medical Sciences (IR.MUMS.NURSE.REC.1401.031).

Use of Artificial Intelligence (AI)

No artificial intelligence (AI) tools were used in the writing or analysis of this manuscript.

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Authors' contribution

All authors contributed to the study conception and design. Material preparation, data collection, and analysis were performed by SR, VG and SRS. The first draft of the manuscript was written by SR, and all authors commented on previous versions of the manuscript. KM reviewed the manuscript critically for important intellectual content. All authors read and approved the final manuscript.

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