BMC Pregnancy and Childbirth

RESEARCH

Open Access

The effect of nutrition education based on the Health Belief Model (HBM) on food intake in pregnant Afghan immigrant women: a semi-experimental study

Somaye Riazi[1], Vahid Ghavami[2], Seyyed Reza Sobhani[3], Nahid Jahani Shoorab[4,5] and Kobra Mirzakhani[4,5*]

Abstract

Background According to the World Health Organization report, immigrants are at increased risk of malnutrition. Nutritional deficiencies in pregnancy are a public health concern and around 20 to 30 percent of pregnant women suffer from it worldwide. There has not been any investigation about the effect of any intervention on improving nutritional intake in pregnant Afghan immigrant women. Therefore, the present study was conducted to determine the effect of nutrition education based on the Health Belief Model (HBM) on food intake in pregnant Afghan immigrant women.

Methods A semi-experimental study study was conducted on 116 Afghan immigrant pregnant women who have the inclusion criteria, were referred to health center No. 2 in Mashhad, Iran in June 2022 until February 2023, and were randomly assigned to the intervention (56) and control (56) groups. The demographic, HBM questionnaire and the standard 24-h food reminder questionnaire were the research tools. The intervention consisted of four sessions of 45–60 min of nutrition education based on the Health Belief Model in groups of 8–10 people. The questionnaires were completed before, immediately, and one month after the intervention by the research units. Data were analyzed with SPSS version 21 software.

Results The intake of energy, protein, carbohydrates, and micronutrients such as iron, calcium, zinc, and vitamin D increased in the intervention group immediately and one month after the intervention significantly compared to before the intervention ($P < 0.05$). Although all these nutrients intake had a significant decrease in control group women ($P < 0.05$).

Conclusions Nutrition education based on the health belief model is effective in the nutritional intake of Afghan immigrant pregnant women. According to the importance of getting enough nutrients in pregnancy and its effects on the mother and fetus's health, nutrition education based on the Health Belief Model model is suggested for these mothers.

Trial registration It is registered in the Iranian clinical trials database under the code: IRCT20220629055312N1, Date of first registration: 25/07/2022.

*Correspondence:
Kobra Mirzakhani
mirzakhanikb@gmail.com
Full list of author information is available at the end of the article

Keywords Health belief model, HBM, Nutrition, Education, Pregnancy, Food, Intake, Macronutrients, Micronutrients, Immigrants

Introduction

The importance of adequate nutrition during pregnancy is crucial for a successful and healthy outcome [1–3]. Insufficient food intake during pregnancy can lead to malnutrition in both the mother and fetus, increasing the risk of miscarriage, congenital abnormalities, low birth weight, and impaired child growth [4, 5]. Additionally, poor maternal nutrition during pregnancy is associated with long-term health risks such as diabetes, kidney diseases, and cardiovascular diseases in adulthood [6–8]. Body mass index during pregnancy is considered a useful index to express the nutritional status of pregnant women. Body mass index is related to macronutrients, energy, and micronutrient intake [9].

Macronutrients, including carbohydrates, proteins, and fats, are essential for normal tissue function and overall health [10, 11]. On the other hand, micronutrients, such as vitamins and minerals, are necessary in smaller quantities and play a critical role in pregnancy outcomes [10]. For instance, folic acid is essential for preventing neural tube defects [12], while iron deficiency can lead to low birth weight [13–15]. Lack of calcium increases the risk of gestational hypertension [13], and vitamin D deficiency is associated with conditions like pre-eclampsia and gestational diabetes [13, 16–18].

Overall, many studies indicate that insufficient micronutrient intake during pregnancy. Karimi et al.'s study (2021) showed that the average intake of iron, iodine, vitamin D, vitamin E, and vitamin B6 in pregnant women was lower than the standard which was recommended daily allowances[1] [19].

The prevalence of malnutrition is significantly high among the general population, especially among the vulnerable population of women and children. Different factors such as war and conflict, forced migration, food insecurity, and limited access to humanitarian aid can affect the nutritional status and worsen poor health consequences. Migration is one of the effective factors in health, nutrition, food intake, and nutritional behavior [20]. According to the World Health Organization (WHO) reports, immigrants are at an increased risk of certain diseases, including malnutrition [21].

Afghans are the second largest refugee population in the world after Syrians [22]. Afghanistan, a low-income country with ongoing conflict and a high refugee population, faces numerous challenges including weak governance, terrorism, poverty, and lack of comprehensive social support systems. These factors contribute to a high prevalence of malnutrition among the population [23]. It is estimated that Afghans die from malnutrition and poverty 25 times more than violence annually [24].

A nutritional survey was conducted by the Afghan Ministry of Public Health and UNICEF in 2013 and they recorded widespread micronutrient deficiencies among reproductive-age women, in this way, 40.4% had anemia, 23.4% had zinc deficiency and 64.7% had severe vitamin D deficiency [24]. Iran is one of the main host countries for Afghan refugees [25].

Despite the recent increase in researches which are related to immigrant health, important knowledge gaps remain about food and nutrition issues yet [21].

In Pakrovan's (2020) study, adverse nutritional behavior and socio-economic factors that have affected them were evaluated among Afghan immigrants in Tehran and Mashhad, two big cities of Iran. The results showed that 60–77 percent of them faced moderate to severe food insecurity [26]. Another study showed that more than 84% of Afghan immigrant families in Iran are faced with food insecurity [27].

Adverse nutritional status and food insecurity in Afghan women have an inverse relationship with their literacy and education and literate and educated women can plan for their family's nutrition in a better way and reduce the possibility of undesirable nutritional behavior and food insecurity [27].

The inverse relationship between adverse nutritional status and education suggests that empowering women with knowledge and skills through health education programs can play a crucial role in improving their dietary behaviors and overall health outcomes [28, 29]. Nutrition education, as demonstrated in previous studies, has the potential to positively impact food choices and nutrient intake among pregnant women [30, 31].

In Iran, the necessary education for pregnancy is provided based on the standard prenatal care programs for pregnant women currently but it is far from the desired level [29, 32, 33]. Although the health care provider's information is important, but it seems that because of the high density of the covered population, the lack of time and education about necessary counseling skills, the nutritional education of pregnant women is not done sufficiently by health care providers [34]. So the use of models and theories of changing behavior, considering individual and environmental characteristics that have

[1] RDA (Recommended Dietary Allowance).

affected the behaviors, can increase the effect of health education programs [35]. Theories and models are essential components to guide health behavior educators. Meanwhile, HBM is one of the proposed models in the field of nutrition education programs [36, 37]. The existence of the HBM's constructs that included perceived sensitivity, perceived intensity, perceived benefits, perceived barriers, action indications, and self-efficacy is one of the advantages of this model. The basis of this model is the people's motivation to act and it emphasizes the individual's perceptions and beliefs about the people's fear of the health problem and an individual's assessment of the benefits and barriers of the behavior that become the reason for correct behavior to be adopted [2, 38]. Although the HBM model, has been used as a framework for nutrition education and health behavior changes in various studies, including Sasanfar (2022) [37], Moitra (2021) [39], Mohammadi (2019) [40], Saadat Niya (2018) [41], Baji (2018) [42], Diddana (2017) [43], Ziyai (2017) [28], Khorramabadi (2016) [36], Karimi (2016) [2] and Tavakoli (2016) [44, 45] and the effectiveness and appropriateness of this model about the nutrition education has been proven, but the nutrition education's effectiveness based on HBM model has not been investigated on the Afghan population, especially pregnant immigrant women.

Despite the recent increase in immigrant health-related researches, there are important gaps in food and nutrition issues yet. According to the suggestions of the studies and researches about the nutrition and nutritional behaviors of immigrants, more researches are needed to determine the factors affecting to dietary acculturation and nutrition behavior suh as education based on the HBM model about the intake of micronutrients and macronutrients in different immigrant subgroups [21]. Due to the importance of pregnant women's nutrition, the researchers decided to conduct a study to determine the effect of education based on the HBM model on food intake in pregnant Afghan immigrant women in Mashhad.

Methods

The present study was a semi-experimental study, which was conducted after getting the ethics code from Mashhad University of Medical Sciences (IR.MUMS.NURSE.REC.1401.031) and the IRCT code (IRCT20220629055312N1), with an official introduction from Mashhad School of Nursing and Midwifery.

Due to that the majority of the Afghan immigrant population of this city live in the covered areas of Health Center No. 2 of Mashhad, this health center was chosen as the research environment. Four centers of Amir al Momenin, Bafti, Golshahr and Mehrabad were selected from the centers covered by Health Center number 2 of this city randomly. Then, the centers of Amir al-Momenin (AS) and Bafti were allocated to the intervention group, and the centers of Golshahr and Mehrabad were allocated to the control group randomly. The social, economic and cultural characteristics of the intervention and control centers were similar; They were also similar in terms of facilities, service delivery, and how to education patients. however, in order to eliminate bias in the allocation of the centers, they were randomly assigned to the intervention or control group. In this way, in each center, Afghan pregnant people with a pregnancy record were identified from the list of covered people, and then the people were selected by systematic randomness method until the number of research units reached the quorum. The researcher called the selected people to invite them to the research and stated the objectives of the research, introducing the research team, goals and the schedule of training sessionsand if they had the inclusion criteria, they entered the research after obtaining written consent. The required sample size was determined 50 people in each group due to the error level of 0.05 and the test power of 80%. Assuming 15% attrition, the final sample size of 58 people in each group was determined.

$$R\left[\frac{1+(w-1)P_T}{w}-\frac{vP\frac{2}{T}}{1+(v-1)P_T}\right]$$

$$w \geq 1\ 0$$

$$m_{repeated}=R\left[\left(1+\frac{1}{\lambda}\right)^2\frac{\left(z_{1-\alpha/2}+z_{1-\beta}\right)^2}{\Delta^2{}_{plan}}+\frac{z^2{}_{1-\alpha/2}}{4}\right]$$

Population

Afghan immigrant pregnant women with a gestational age of less than 20 weeks were included in the study based on the first trimester of pregnancy sonography and who met other inclusion criteria. The inclusion criteria include informed consent of the mother, being Afghan, healthy woman[2] with single fetus pregnancy, desired pregnancy, age over 18 years and at least literate in reading and writing, having a contact number, not participating in another study at the same time, absence of disease requiring intervention in mother or fetus,[3] absence of chronic systemic disease,[4] not following a specific diet,[5] absence of severe emotional and mental disorders in the

[2] It was determined by self-report and examination of the mother's health record.

[3] Appetite, bleeding, preterm labor, urinary infection, hypertension, anemia, RH incompatibility, malignant nausea and vomiting of pregnancy, preterm rupture of fetal membranes.

[4] Kidney disease, hypertension, heart disease, diabetes.

[5] Vegetarian diet or non-use of certain food groups.

mother,[6] No smoking and drug addiction and having a legal residence permit in Iran.

The exclusion criteria include unwillingness to continue research, not participating in more than one educational session, failure to answer more than 10% of the questions in the questionnaire, and the occurrence of severe emotional and mental disorders in the mother during the research.[7]

Tools and questionnaire

The demographic questionnaire and a 24-h food reminder questionnaire were the data collection tools in this study. The demographic questionnaire included age, education, occupation, marital status, husband's education, husband's occupation, family income, housing status, weight, height, body mass index, gestational age, gravida, abortion, stillbirth, and pregnancy complications. The 24-h food reminder questionnaire had three tables to insert the food consumed in daily meals, including the three main meals of breakfast, lunch, and dinner, and three optional snacks. Each table collected information about meals for the day. In each meal, the name of the food, household scale (ingredients of the food, the total amount of cooked food, the amount consumed by the individual), the consumption amount in grams, and the food code were entered separately. Information about the meals of two non-holidays and one holiday of the research units in three periods (before the educational intervention, immediately, and one month after the educational intervention) was entered in addition, The HBM questionnaire, a questionnaire comprising 40 questions was developed by the researcher through Literature review. HBM questionnaire was carefully crafted to assess perceived sensitivity, perceived intensity, perceived benefits, perceived barriers, action indications, and self-efficacy. A five-point Likert scale (completely agree, agree, have no opinion, disagree, and completely disagree) was used to respond to questions related to these constructs.Face validity was evaluated using qualitative and quantitative methods. Thus face-to-face interviews were held with ten pregnant Afghan immigrant women to ask them to comment on the ambiguity, appropriateness, and difficulty of each HBM questionnaire item.In quantitative face validity evaluation, impact score.

Was calculated for each item.Content validity was evaluated using qualitative and quantitative methods. In qualitative evaluation of content validity, eight experts and faculty members from Mashhad University of Medical Sciences assessed the wording, grammar and scaling of the items. The Content validity index (CVI) 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. The content validity ratio (CVR) were determined to be 0.75. The questionnaire's reliability was confirmed with a Cronbach's alpha of 0.87.

Then the results were checked by the Nutritionist 4 software and the amount of calories, micronutrients, and macronutrients consumed by people, or in other words, the amount of people's food intake, was analyzed.

The demographic, 24-h food reminders questionnaires and questionnaires designed according to the frame work of the HBM model was completed by research units with the guidance and explanations of the researcher at first as pre_test. In case of low literacy, the researcher personally completed the 24-h food reminder form after obtaining the information about the meals of these research units.

Intervention and analysis

The first author in groups of 8–10 people conducted the nutrition educational intervention based on the HBM model's structures during 4 sessions of 45–60 min.

The educational content in the first session emphasized on increasing nutritional knowledge and awareness, the second session was based on the constructs of perceived sensitivity and intensity, the third session was based on the constructs of perceived benefits and barriers and the fourth session was presented based on self-efficacy and practice guidelines (Table 1).

Teaching methods, including brainstorming, group discussion, question and answer, and lectures were used alternately and appropriately. The control group received routine care and they received the content of the education in the form of a booklet at the end of the research.

Follow up time of effect of intervention was considered immediately and one month after intervention, Based on other similar studies and because of the short period of pregnancy and pregnancy conditions, this period was considered for assay [4, 28].

The collected data was entered into SPSS software version 21. The data was described by central and appropriate dispersion indices. The chi-square test (or Fisher's exact test if needed) was used to check the distribution of qualitative demographic and clinical variables, According to the normal or non-normal distribution of demographic and clinical variables, independent t-tests or Mann–Whitney tests were used. Shapiro–Wilk tests were used to check the normality of the data and 0.05 was considered as a significant level. To check the changes in food intake, the repeated measures test (if the nutrient distribution is normal) or Friedman's test (if the nutrient distribution is non-normal) was used. All statistical

[6] Depression, bipolar disorder, recent separation from a spouse, loss of a family member.

[7] Separation from spouse, loss of a family member.

Table 1 Educational sessions's content

First session	It was emphasized to increase the nutritional knowledge and awareness of pregnant Afghan immigrant women to improve their attitude about the importance of correct nutritional behavior and nutrition during pregnancy. The general principles of nutrition, food pyramid and groups were presented by educational methods such as lectures, slide shows, group discussion about the experiences of pregnant mothers about the effects of nutrition on their health, and, a pamphlet was given to the mothers. At the end, the contents and summary of the session were reviewed and the assignments for the next session were presented
Second session	The structure of perceived sensitivity and intensity was emphasized in this session. The purpose of this session was to familiarize the person with nutritional disorders in pregnancy, her perceived sensitivity and intensity related to the complications of nutritional disorders in pregnancy, and its effect on the mother and the fetus's health. The experiences of pregnant women regarding the complications of unhealthy eating behavior during pregnancy, the appropriate behaviors in food shopping, and the nutrition label of food were discussed by using educational methods such as lectures, slide shows, and group discussions. At the end, the contents and summary of the session were reviewed and the assignments for the next session were presented
Third session	Considering the constructs of perceived benefits and barriers, it was emphasized to recognize these constructs in the implementation of healthy nutritional behavior in pregnant Afghan immigrant women. At first, the review of the previous session was done with the educational method of planned lecture and slide shows and then the appropriate nutritional recommendations that lead to the improvement of the mother and the fetus's health and the benefits of proper nutrition for them were stated. Therefore, the barriers to the implementation of appropriate nutritional behaviors, the importance of physical activity during pregnancy, and its role in health and weight control were explained through group discussion, brainstorming, and slide shows. At the end, the contents and summary of the session were reviewed and the assignments for the next session were presented
Fourth session	Suggestions about increasing the capability and self-efficacy of the research units were presented based on the self-efficacy and action indication structures. The educational methods of group discussion, brainstorming, and slide shows were used. Brainstorming was the strategy for achieving self-efficacy in Afghan immigrant pregnant women. At first, the contents of the previous session were reviewed and then suggestions about the proper food cooking method and solutions for variety in diet with less spending were discussed through group discussion and slide shows. After that, the contents were summarized and reviewed. At the end, the researcher's questionnaire based on the constructs of the health belief model, nutritional behavior, and 24-h food reminder questionnaire were completed by the research units

analyses were performed in SPSS version 21 and an A significance level of 0.05 is considered.

Results

The average age of pregnant Afghan immigrant women was 29.92 ± 6.15 years. Most of the women (46%) had middle and high school education. 90% of the research units were housewives. 97% of the mothers were Shia and 80% had Hazara ethnicity. The housing status of most of them were rented houses. The average monthly family income was 128 ± 99 dollars. According to the results of chi-square and Fisher's exact tests, there was no significant difference in age, education, husband's education, occupation, religion, ethnicity, housing status, length of residence in Iran, and family income between the two groups of intervention and control and the two groups were homogeneous in terms of these characteristics ($P \leq 0.05$).

Energy and macronutrients

There was not a significant difference in the mean and standard deviation of the total score of energy intake and macronutrients in the two groups of intervention and control before the intervention ($P \geq 0.05$). While immediately and one month after the intervention, there was a statistically significant difference between the intervention and the control group ($P < 0.05$).

Fat intake: Before the intervention, the mean and standard deviation of the total score of fat intake in both intervention and control groups had no significant difference based on the Mann–Whitney test results ($P = 0.427$), while immediately ($P = 0.004$) And one month after the intervention, there was a significant difference between the intervention group and the control group ($P < 0.001$)., (Table 2).

Protein intake: before the intervention, there was no significant difference between the mean and standard deviation of the total score of protein intake in the intervention and control groups ($P = 0.106$). However, immediately ($P = 0.001$) and one month after the intervention, there was a significant difference in the two groups ($P < 0.001$), (Table 2).

Carbohydrate intake: The change in the total score of carbohydrate intake immediately after the intervention compared to before the intervention showed a significant increase in the intervention group, while it showed a significant decrease in the control group ($P < 0.001$). Also, the change in the total carbohydrate intake score one month after the intervention compared to before the intervention increased in the intervention group and decreased in the control group. This difference was significant ($P < 0.001$), (Table 2).

The change in the total score of energy intake immediately after the intervention and one month after the intervention compared to before the intervention increased in the intervention group, while it decreased in the control group, which according to the results of the Mann–Whitney test, this difference was significant ($P < 0.001$). Also, in the intra-group comparison of the total energy intake score, there was

Table 2 Comparison of intra and inter-group changes in the total macronutrient and energy intake score

Variable	control group SD ± mean	Intervention group SD ± mean	Intergroup test results	Effect sizes
The total score of fat intake before the intervention	42.0 ± 16.8	49.6 ± 74.5	$P=0.427^{*}$	0.1
The total score of fat intake immediately after the intervention	40.9 ± 15.0	51.1 ± 18.5	$P=0.004^{*}$	0.2
The total score of fat intake one month after the intervention	37.0 ± 15.5	50.5 ± 19.7	$P<0.001^{*}$	0.3
Changes in the total score of fat intake immediately after the intervention compared to before the intervention	-1.2 ± 16.6	0.2 ± 77	$P=0.005^{*}$	0.2
Changes in the total score of fat intake one month after the intervention compared to before the intervention	-5.1 ± 18.1	- 0.3 ± 77.3	$P=0.003^{*}$	0.2
The results of the intragroup test***	$P=0.230^{**}$	$P=0.025^{**}$		
The total score of protein intake before the intervention	52.9 ± 18.5	48.0 ± 22.2	$P=0.106^{*}$	0.1
The total score of protein intake immediately after the intervention	49.4 ± 16.9	60.8 ± 21.7	$P=0.001^{*}$	0.2
The total score of protein intake one month after the intervention	44.4 ± 17.4	63.5 ± 22.5	$P<0.001^{*}$	0.4
Changes in the total score of protein intake immediately after the intervention compared to before the intervention	-3.8 ± 17.5	11.7 ± 29.2	$P=0.001^{*}$	0.3
Changes in the total score of protein intake one month after the intervention compared to before the intervention	-8.9 ± 19.5	14.4 ± 30.4	$P<0.001^{*}$	0.4
The results of the intragroup test***	$P=0.006^{**}$	$P=0.001^{**}$	$P=0.015^{*}$	0.2
The total score of carbohydrate intake before the intervention	230.3 ± 90.5	192.4 ± 72.9	$P=0.044^{*}$	0.1
The total score of carbohydrate intake immediately after the intervention	224.0 ± 86.0	259.8 ± 125.0	$P<0.001^{*}$	0.3
The total score of carbohydrate intake one month after the intervention	207.7 ± 79.2	279.25 ± 119.2	$P<0.001^{*}$	0.3
Changes in the total score of carbohydrate intake immediately after the intervention compared to before the intervention	-7.2 ± 89.8	65.12 ± 1	$P<0.001^{*}$	0.5
Changes in the total score of carbohydrate intake one month after the intervention compared to before the intervention	-23.4 ± 90.1	84.5 ± 127.2	$P=0.015^{*}$	0.2
The results of the intragroup test***	$P=0.417^{**}$	$P<0.001^{**}$		
The total score of energy intake before the intervention	1488.5 ± 4492.5	1297.1 ± 499.8	$P=0.049^{*}$	0.1
The total score of energy intake immediately after the intervention	1436.5 ± 478.1	1717.2 ± 662.4	$P=0.005^{*}$	0.2
The total score of energy intake one month after the intervention	1314.1 ± 451.3	1796.6 ± 664.3	$P<0.001^{*}$	0.4
Changes in the total score of energy intake immediately after the intervention compared to before the intervention	-58.0 ± 457.2	400.4 ± 698.2	$P<0.001^{*}$	0.3
Changes in the total score energy intake one month after the intervention compared to before the intervention	-180.4 ± 498.6	479.8 ± 732.9	$P<0.001^{*}$	0.5
The results of the intragroup test***	$P=0.009^{**}$	$P<0.001^{**}$		

**Mann-Whitney test

**Friedman test

***Comparison of times before, immediately after and one month after the intervention

a significant increase in the intervention group ($P<0.001$), while the difference between the steps in the control group showed a significant decrease ($P=0.009$), (Table 2).

Micronutrients

There was no significant difference in the mean and standard deviation of the total score of micronutrient intake between the intervention and control groups before the intervention ($P \geq 0.05$). While immediately and one month after the intervention, there was a statistically significant difference between the intervention and the control group ($P<0.05$), (Table 3).

Iron intake: Immediately ($P=0.022$) and one month after the intervention, the mean and standard deviation of the total score of iron intake in the two groups showed a significant difference ($P<0.001$). The change in the total score of iron intake immediately after After the intervention compared to before the intervention, there was an increase in the intervention group, while there was a significant decrease in the control group ($P=0.001$), (Table 3).

Calcium intake: the mean and standard deviation of the total score of calcium intake immediately ($P=0.001$) and one month after the intervention, the mean and standard deviation of the total score of calcium intake in the intervention group were significantly different from the control group ($P<0.001$), (Table 3).

Folic acid intake: Immediately ($P=0.014$) and one month after the intervention, the mean and standard deviation of

Table 3 Comparison of intra and inter-group changes in the total micronutrient score

Variable	control group SD ± mean	Intervention group SD ± mean	Intergroup test results	Effect sizes
The total score of iron intake before the intervention	10.8 ± 4.4	9.7 ± 3.8	$P = 0.225^{*}$	0.1
The total score of iron intake immediately after the intervention	10.2 ± 3.3	12.1 ± 5.7	$P = 0.022^{*}$	0.2
The total score of iron intake one month after the intervention	9.2 ± 3.1	12/4 ± 5.8	$P < 0.001^{*}$	0.4
Changes in the total score of iron intake immediately after intervention compared to before the intervention	-0.6 ± 4.4	2/2 ± 6.3	$P = 0.001^{*}$	0.3
Changes in the total score of iron intake one month after intervention compared to before the intervention	-1.7 ± 4.2	2.5 ± 6.7	$P < 0.001^{*}$	0.4
The results of the intragroup test***	$P < 0.001^{**}$	$P = 0.001^{**}$		
The total score of calcium intake before the intervention	492.4 ± 230.0	501.8 ± 304.3	$P = 0.623^{*}$	0.4
The total score of calcium intake immediately after the intervention	459.3 ± 237.9	587.7 ± 239.5	$P = 0.001^{*}$	0.3
The total score of calcium intake one month after the intervention	412.0 ± 211.8	580.7 ± 233.3	$P < 0.001^{*}$	0.4
Changes in the total score of calcium intake immediately after intervention compared to before the intervention	-38.6 ± 263.2	75.5 ± 372.4	$P = 0.001^{*}$	0.2
Changes in the total score of calcium intake one month after intervention compared to before the intervention	-85.9 ± 268.9	68.6 ± 361.7	$P < 0.001^{*}$	0.3
The results of the intragroup test***	$P = 0.004^{**}$	$P = 0.001^{**}$		
The total score of folic acid intake before the intervention	192.1 ± 129.9	190 ± 114.6	$P = 0.985^{*}$	0.004
The total score of folic acid intake immediately after the intervention	192.5 ± 110.7	238.9 ± 114.9	$P = 0.014^{*}$	0.2
The total score of folic acid intake one month after the intervention	172.5 ± 109.2	263.9 ± 108.3	$P < 0.001^{*}$	0.4
Changes in the total score of folic acid intake immediately after the intervention compared to before the intervention	-1.7 ± 143.5	44.5 ± 153.8	$P = 0.175^{*}$	0.1
Changes in the total score of folic acid intake one month after the intervention compared to before the intervention	-21.6 ± 137.5	69.5 ± 151.5	$P = 0.001^{*}$	0.3
The results of the intragroup test***	$P = 0.257^{**}$	$p = 0.001^{**}$		
The total score of zinc intake before the intervention	5.5 ± 2.9	5.1 ± 2.9	$P = 0.284^{*}$	0.1
The total score of zinc intake immediately after the intervention	4.9 ± 2.2	6.1 ± 2.6	$P = 0.004^{*}$	0.2
The total score of zinc intake one month after the intervention	4.4 ± 2.2	6.1 ± 2.5	$P < 0.001^{*}$	0.3
Changes in the total score of zinc intake immediately after the intervention compared to before the intervention	-0.68 ± 2.6	0.9 ± 3.5	$P = 0.023^{*}$	0.2
Changes in the total score zinc intake one month after the intervention compared to before the intervention	-1.1 ± 2.6	0.8 ± 3.7	$P < 0.001^{*}$	0.3
The results of the intragroup test***	$P = 0.007^{**}$	$P = 0.065^{**}$		
The total score of vitamin D intake before the intervention	2.2 ± 1.4	2.2 ± 1.4	$P = 0.886^{*}$	0.01
The total score of vitamin D intake immediately after the intervention	2.1 ± 1.4	2.9 ± 1.6	$P = 0.002^{*}$	0.2
The total score of vitamin D intake one month after the intervention	2.0 ± 1.4	2.6 ± 1.5	$P = 0.012^{*}$	0.2
Changes in the total score of vitamin D intake immediately after the intervention compared to before the intervention	-0.1 ± 1.4	0.6 ± 1.8	$P = 0.003^{*}$	0.2
Changes in the total score vitamin D intake one month after the intervention compared to before the intervention	-0.2 ± 1.4	0.3 ± 1.8	$P = 0.045^{*}$	0.1
The results of the intragroup test***	$P = 0.355^{**}$	$P = 0.027^{**}$		
The total score of dietary fiber intake before the intervention	13.1 ± 9.9	11.97 ± 5.8	$P = 0.956^{*}$	0.005
The total score of dietary fiber intake immediately after the intervention	13.6 ± 7.9	14.0 ± 5.1	$P = 0.153^{*}$	0.1
The total score of dietary fiber intake one month after the intervention	11.9 ± 7.1	15.6 ± 4.8	$P < 0.001^{*}$	0.3
Changes in the total score of dietary fiber intake immediately after the intervention compared to before the intervention	0.2 ± 9.86	1.9 ± 5.8	$P = 0.321^{*}$	0.1
Changes in the total score dietary fiber intake one month after the intervention compared to before the intervention	-1.3 ± 9.4	3.5 ± 6.4	$P = 0.002^{*}$	0.2
The results of the intragroup test***	$P = 0.218^{**}$	$p = 0.005^{**}$		

*Mann-Whitney test

**Friedman test

***Comparison of times before, immediately after and one month after the intervention the total score of folic acid intake showed a significant difference in the two groups ($P<0.001$), (Table 3).

Zinc intake: Immediately ($P=0.004$) and one month after the intervention, there was a significant difference in the two groups ($P<0.001$). The change in the total zinc intake score immediately after the intervention compared to before the intervention increased in the intervention group, but decreased in the control group, which was a significant difference ($P=0.023$), (Table 3).

Vitamin D intake: Immediately ($P=0.002$) and one month after the intervention, there was a significant difference in the two groups ($P=0.012$). The change in the total score of vitamin D intake immediately after the intervention compared to before the intervention increased in the intervention group and decreased in the control group, and this difference was significant ($P=0.003$). Also, the change in the total score of vitamin D intake one month after the intervention compared to before the intervention increased in the intervention group and decreased in the control group, and these changes were significant ($P=0.045$). In the intra-group comparison, the total score of vitamin D intake in the intervention group showed a significant increase between the stages ($P=0.027$), while the difference between the stages in the control group was not significant ($P=0.355$), (Table 3).

Dietary fiber intake: The mean and standard deviation of the total score of dietary fiber intake before the intervention was not significantly different in the intervention group and the control group ($P=0.956$), immediately after the intervention there was no significant difference in the two groups (153. $P=0$), while one month after the intervention, there was a significant difference between the intervention group and the control group ($P<0.001$). There was no significant difference in the total score of dietary fiber intake immediately after the intervention compared to before the intervention in the two groups ($P=0.321$), while one month after the intervention compared to before the intervention, it increased in the intervention group. It decreased in the control group, and this difference was significant ($P=0.002$). In the intra-group comparison, the difference between the stages was significant in the intervention group ($P=0.005$), while this difference was not significant in the control group ($P=0.218$), (Table 3).

Nutritional knowledge

The constructs of perceived sensitivity and perceived intensity in the health Belief model show the knowledge. The total score of perceived sensitivity and perceived severity in the intervention group compared to before the intervention and the control group increased significantly ($P<0.001$) (Table 4).

Discussion

The results of this research showed that nutrition education based on the HBM was effective on macronutrient intake and caused a significant increase in these nutrients intake. While the macronutrient intake showed a significant decrease in women who were in the control group. Nutrition education based on HBM improves calorie intake in the intervention group significantly while the energy intake was reduced in the control group. Also, the results of the present study showed a significant increase in micronutrients intake such as iron, calcium, zinc, and vitamin D after nutrition education based on the health belief model. Although the folic acid intake increased among women in the intervention group, but that was not significant after the intervention immediately, however, it showed a significant increase in the monthly survey after the educational intervention. This is while women in the control group had a decrease in folic acid intake both immediately and one month after the intervention.

The results of the study by Odiwuor et al. (2022), which was conducted to investigate the effect of nutrition education on nutrient intake and pregnancy outcomes in Western Kenya, showed that the amount of all macronutrients received by the mother increases with nutrition education [46] which supports the results of the present study. Also, the results of Araban's study (2017) showed that nutrition education based on the HBM has been effective in improving and increasing the amount of energy intake [47]. The study of Odiwuor et al. (2022) showed that nutrition education based on the HBM caused a significant increase in the intake of micronutrients like iron, calcium, zinc, and folic acid in the intervention group after nutrition education [46] and in this sense, it was consistent with the results of the present study. Hasniza's (2020) study, which was conducted to determine the effect of the intervention based on the HBM to improve the hemoglobin level in women suffering from anemia during pregnancy, showed that the amount of iron intake in the intervention group women has been increased after the educational intervention based on the HBM [48]. The results of this study are consistent with the results of the present study.

Based on the results of the present study, the HBM-can be considered as a comprehensive model and the structures of this model can improve food intake and micronutrients in all populations and cultures even in low-income populations and immigrants who are a vulnerable group and threatened in food security [26, 49]. Nutritional deficiencies during pregnancy are considered as a public health disorder in this deprived and endangered population [10], so this model can be used effectively.

Table 4 Comparison of intra-group and inter-group changes in Nutritional knowledge (perceived sensitivity and perceived intensity)

Variable		control group SD ± mean	Intervention group SD ± mean	Intergroup test results	Effect sizes
Perceived sensitivity structure	Score changes immediately after the intervention compared to before the intervention	-2.1 ± 12.8	11.68 ± 11.3	$P < 0.001^{*}$	0.5
	Score changes one month after the intervention compared to before the intervention	-1.4 ± 12.7	13 ± 1	$P < 0.001^{*}$	0.5
	The results of the intragroup test***	$P = 1^{**}$	$P < 0.001^{**}$		
Perceived intensity construct	Score changes immediately after the intervention compared to before the intervention	- 0.2 ± 12.4	12.2 ± 13.2	$P < 0.001^{*}$	0.4
	Score changes one month after the intervention compared to before the intervention	-0.2 ± 12.4	13.2 ± 14.3	$P < 0.001^{*}$	0.4
	The results of the intragroup test***	$^{*}P = 0.882^{**}$	$P < 0.001^{**}$		

*Mann-Whitney test

**Friedman

***Comparison of times before, immediately after and one month after the intervention

The results of the present study showed a significant decrease in the intake of energy and all macronutrients, such as protein and carbohydrates, as well as a significant decrease in the intake of micronutrients such as iron, calcium and zinc in the control group. Although the intake of micronutrients like folic acid and vitamin D also decreased, but this decrease was not significant. This reduction of nutrient intake in the control group can be caused due to the family income which was below the international poverty line (announced by the World Bank in 2022) [50] of most Afghan families. The relationship between family income level and nutrient intake has been proven in many studies [51–54]. Also, another reason could be the high prevalence of food insecurity in the Afghan immigrant population in Iran [26, 49]. In addition, it can be taught that women as the ones who manage the family nutrition, are exposed to food insecurity in many cases because they give priority to children and other family members and it would be possible that they will starve or not get enough food [26]. Also, we can mention the role of gestational digestive disorders that increase with higher gestational age and their effects on reducing the intake of effective nutrients. The HBM can solve the physical problems caused by pregnancy by modifying the lifestyle and increasing the self-efficacy of pregnant women.

The results of the present study showed the positive effect between education based on the HBM and food intake of all macronutrients and micronutrients in Afghan pregnant women, it can be concluded that the HBM is comprehensive and it can increase the sensitivity and intensity and decrease perceived barriers. This model can increase the intake of nutrients that women need during pregnancy and it helps the mother to overcome various barriers such as the lack of access to food and its high cost, the healthy way of cooking and storing food, and finally helps her to create a positive behavior change. Results of this research can be of interest to midwives, health care workers and doctors to use this model in pregnancy nutrition education programs will improve and promote nutritional behavior among pregnant women. In addition, managers in relevant departments, especially in international organizations related to the rights of immigrants and refugees, can, with proper planning, provide the necessary conditions for effective nutrition education based on the health belief model among the population of pregnant women. Provide Afghan immigrants.

One of the advantages of the present study was the overview of pregnant women's nutrient intake and their analysis and measurement by using standard tools and specialized software for nutrient analysis. Completion of the food reminder tool was much time-consuming and it was one of the limitations of this research, which increased the possibility of the research units dropping out, but the questionnaire completion was clarified by the researcher and the questionnaire was completed by the researcher herself in necessary cases. Due to the role of environmental and cultural factors on nutritional behavior and food intake, it is suggested to conduct a comparative study about the effect of education based on the HBM on the nutrient intake in pregnant Afghan immigrant women and Iranian women, and then compare it with women who live in Afghanistan.

Conclusion

Nutrition education based on HBM is effective on the nutrient intake of pregnant Afghan immigrant women and improves it.Based on the results of the present study, the HBM can be considered as a comprehensive model. The structures of this model can improve food intake and micronutrients in all populations and cultures even in low-income populations and immigrants who are a vulnerable group and threatened in food security. Results of this research can be of interest to midwives, health care workers to use this model in pregnancy nutrition education programs will improve and promote nutritional behavior among pregnant women. According to that the immigrants are at risk of malnutrition and food insecurity so managers, planners, and international organizations that are related to the immigrant's situation can provide effective nutrition educational programs based on the HBM for pregnant Afghan immigrant women.

Abbreviations

LBW Low birth weight (< 2500 g)
RDA Recommended dietary allowance
HBM Health belief model

Acknowledgements

This article is extracted from the master's thesis of midwifery with grant code 4010054, which was approved by Mashhad University of Medical Sciences. We sincerely thank the Vice Chancellor for Research of Mashhad University of Medical Sciences for supporting this project and also the officials and employees of Amir Al momenin, Bafti, Golshahr, and Mehrgan health centers in Mashhad and pregnant mothers who participated in the study.

Authors' contributions

This study was designed, supervised, and directed by K.M. and S.R., S.R.S was Public Health Nutritionist, Expert in Sustainable Diet, and V.G. conducted the statistical analysis. The HBM was designed with this model in collaboration with N.J. All authors have read and approved the final version, and authors are responsible for answering questions about the article.

Funding

This study was carried out with the financial support of the Research Vice-Chancellor of Mashhad University of Medical Sciences.

Availability of data and materials

All data and materials are available. Data sets used or analyzed during the current study are available upon reasonable request and without jeopardizing participant confidentiality from the corresponding author; mirzakhanikb@gmail.com.

Declarations

Ethics approval and consent to participate
The ethics committee of Mashhad University of Medical Sciences with the ethics code: IR.MUMS.NURSE.REC.1401.031 has approved the present study. The Ethics Committee approved all the procedures and written informed consent obtained from the participants. If any person does not want to continue the research at any stage of the research, they could be excluded from the study without any interruption in the provision of services.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

Author details
[1]Student Research Committee, Mashhad University of Medical Sciences, Mashhad, Iran. [2]Department of Biostatistics and Epidemiology, School of Health, Mashhad University of Medical Sciences, Mashhad, Iran. [3]Department of Nutrition, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran. [4]Nursing and Midwifery Care Research Center, Mashhad University of Medical Sciences, Mashhad, Iran. [5]Department of Midwifery, School of Nursing and Midwifery, Mashhad University of Medical Sciences, Mashhad, Iran.

Received: 5 June 2024 Accepted: 30 July 2024
Published online: 25 October 2024

References

1. Ballot DE, Chirwa TF, Cooper PA. Determinants of survival in very low birth weight neonates in a public sector hospital in Johannesburg. BMC Pediatr. 2010;10(1):1–11.
2. Karimy M, Taher M, Azarpira H. Measurement of health belief model construct in relation with nutritional practices of pregnant women in Saveh university of medical sciences. Sci J Hamadan Nurs Midwifery Fac. 2016;24(3):167–73.
3. Ludwig DS, Currie J. The association between pregnancy weight gain and birthweight: a within-family comparison. The Lancet. 2010;376(9745):984–90.
4. Abedini Z, Gaini M, Rad AK. Dietary Food Intake of Pregnant Women Based on Food Guide Pyramid and Its Related Factors. Iran J Nurs. 2011;24(73):36–46.
5. Ebrahimof S, Sohrab G, Zerafat N. Nutrition during life stages. Tehran: Marze danesh; 2009.
6. Jalily M, Barati M, Bashirian S. Using social cognitive theory to determine factors predicting nutritional behaviors in pregnant women visiting health centers in Tabriz. Iran Journal of Education and Community Health. 2015;1(4):11–21.
7. Karimy M, Taher M, Fayazi N, Bayati S, Rezaei E, Rahnama F. Beliefs effective on nutritional practices of pregnant women in health centers of Saveh. Iran J Educ Community Health. 2015;2(3):28–35.
8. Shakeri M. The effect of educational program based on basnef model on the nutritional behavior of pregnant women. Int Res J Applied Basic Sci. 2013;5(12):1606–11.
9. Alizadeh S, Namazi A, Delbari M. Relationship of pre-pregnancy maternal body mass index and neonatal outcomes. Koomesh. 2012;13(4):445–51.
10. Berdanier CD, Berdanier LA, Zempleni J. Advanced Nutrition: Macronutrients, Micronutrients, and Metabolism (1st ed.). CRC Press; 2008. https://doi.org/10.1201/9781420055559.
11. Tasgin E. Macronutrients and micronutrients in nutrition. Int J Innov Res Rev. 2017;1(1):10–15.
12. Mousa A, Naqash A, Lim S. Macronutrient and micronutrient intake during pregnancy: an overview of recent evidence. Nutrients. 2019;11(2):443.
13. Aparicio E, Jardí C, Bedmar C, Pallejà M, Basora J, Arija V, et al. Nutrient Intake during Pregnancy and Post-Partum: ECLIPSES Study. Nutrients. 2020;12(5):1325.
14. Blumfield ML, Hure AJ, Macdonald-Wicks L, Smith R, Collins CE. Micronutrient intakes during pregnancy in developed countries: systematic review and meta-analysis. Nutr Rev. 2013;71(2):118–32.
15. King SE, Yeh PT, Rhee DK, Tuncalp O, Rogers LM, Narasimhan M. Self-management of iron and folic acid supplementation during pre-pregnancy, pregnancy and postnatal periods: a systematic review. BMJ Global Health. 2021;6(5):e005531.
16. Boyle VT, Thorstensen EB, Mourath D, Jones MB, McCowan LM, Kenny LC, et al. The relationship between 25-hydroxyvitamin D concentration in early pregnancy and pregnancy outcomes in a large, prospective cohort. Br J Nutr. 2016;116(8):1409–15.
17. Palacios C, Kostiuk LK, Peña-Rosas JP. Vitamin D supplementation for women during pregnancy. Cochrane Database Syst Rev. 2019;7(7):CD008873.
18. Wei S-Q, Qi H-P, Luo Z-C, Fraser WD. Maternal vitamin D status and adverse pregnancy outcomes: a systematic review and meta-analysis. J Matern Fetal Neonatal Med. 2013;26(9):889–99.
19. Karimi T, Eini-Zinab H, Moslemi Z, Rezazadeh A, Pourvali K. Maternal macronutrient and micronutrient intakes during pregnancy and their associations with BMI for-age z-scores at birth: a cohort study in Tehran. Iran J Nutr Sci Food Technol. 2021;15(4):31–9.
20. Khullar D, Chokshi DA. Challenges for immigrant health in the USA—the road to crisis. The Lancet. 2019;393(10186):2168–74.
21. Sanou D, O'Reilly E, Ngnie-Teta I, Batal M, Mondain N, Andrew C. Acculturation and nutritional health of immigrants in Canada: a scoping review. J Immigr Minor Health. 2014;16:24–34.
22. Iran UIRo. Solutions Strategy for Afghan Refugees (SSAR). 2022. https://www.unhcr.org/ir/solutions-strategy-for-afghan-refugees-ssar/.
23. (UNICEF) UNICsEF. Annual Report Afghanistan. 2017. : United Nations International Children's Emergency Fund (UNICEF). 2017 [updated 2022. Available from: https://www.unicef.org/about/annualreport/files/Afghanistan_2017_COAR.
24. Kim C, Mansoor GF, Paya PM, Ludin MH, Ahrar MJ, Mashal MO, et al. Review of policies, data, and interventions to improve maternal nutrition in Afghanistan. Matern Child Nutr. 2020;16(4):e13003.
25. Naseh M, Potocky M, Stuart PH, Pezeshk S. Repatriation of Afghan refugees from Iran: a shelter profile study. J Int Humanit Action. 2018;3(1):1–12.
26. Pakravan Charvadeh M, Mohammadi-Nasrabadi F. The association between social welfare, food security and diet diversity among Afghan immigrant households in the Southern areas of Tehran province. Iran J Nutr Sci Food Technol. 2020;15(1):11–24.
27. Maarefvand M, Morshedi SZ. Afghan Immigrant Women's Food Security in Farahzad and Shahrerey. Qtrly J Soc Work. 2016;5(1):34–40.
28. Ziaee R, Jalili Z, Tavakoli GH. The effect of education based on Health Belief Model (HBM) in improving nutritional behaviors of pregnant women. J North Khorasan University of Med Sci. 2017;8(3):427–37.
29. Shobeiri F, Afshari KD, Nazari S, Nazari S, Farhadian M. Effect of nutritional program on nutritional behavior in pregnant women at Hamadan, Iran. J Postgraduate Med Inst (Peshawar-Pakistan). 2018;32(4):368–71.
30. Goodarzi-Khoigani M, Moghadam MHB, Nadjarzadeh A, Mardanian F, Fallahzadeh H, Mazloomy-Mahmoodabad S. Impact of nutrition education in improving dietary pattern during pregnancy based on pender's health promotion model: A randomized clinical trial. Iran J Nurs Midwifery Res. 2018;23(1):18.
31. Murakami K, Miyake Y, Sasaki S, Tanaka K, Ohya Y, Hirota Y. Education, but not occupation or household income, is positively related to favorable dietary intake patterns in pregnant Japanese women: the Osaka Maternal and Child Health Study. Nutr Res. 2009;29(3):164–72.
32. Bashirian S, Jalili M, Karimi-Shahanjarini A, Soltanian A, Barati M. Effectiveness of educational program based on social cognitive theory constructs to promote nutritional behaviors among pregnant women in Tabriz. Iran J Nutr Sci Food Technol. 2017;12(3):1–10.
33. Mirmolaei S, Moshrefi M, Kazemnejad A, Farivar F, Morteza H. The Effect of Nutrition Education on Nutritional Behaviors in Pregnant Women. Hayat. 2009;15(4):35–42.
34. Hazrati S, Mardi A, Alijahan R, Nemati A, Tazakori Z, Nezhaddadgar N. Nutritional Behavior and Weight Gain Change in Pregnant Women by Counseling, in Ardabil Health Centers: An Action Research Study. J Health. 2015;6(5):479–87.
35. Jackson C. Behavioral science theory and principles for practice in health education. Health Educ Res. 1997;2(1):105–43.

36. Khoramabadi M, Dolatian M, Hajian S, Zamanian M, Taheripanah R, Sheikhan Z, et al. Effects of education based on health belief model on dietary behaviors of Iranian pregnant women. Global J Health Sci. 2016;8(2):230.
37. Sasanfar B, Toorang F, Rostami S, Yeganeh MZ, Ghazi ML, Seyyedsalehi MS, et al. The effect of nutrition education for cancer prevention based on health belief model on nutrition knowledge, attitude, and practice of Iranian women. BMC Women's Health. 2022;22(1):1–9.
38. Nooshin P, Mehrsadat M, Mousa M. Evaluation of education in promoting healthy lifestyle behaviors among adolescent girls, according to the Health Belief Model. J Sabzevar University Med Sci. 2014;21(1):164–74.
39. Moitra P, Madan J, Verma P. Impact of a behaviourally focused nutrition education intervention on attitudes and practices related to eating habits and activity levels in Indian adolescents. Public Health Nutr. 2021;24(9):2715–26.
40. Mohammadi N, Hooshian M, Omidi A, Soltanian A. The effect of health belief model education on nutrition behavior of boys in secondary schools in Hamadan. Avicenna J Nurs Midwifery Care. 2019;26(6):397–406.
41. Saadatnia S, Soltani F, Saber A, Kazemi F. The effect of group counseling based on health belief model on nutritional behavior of pregnant women with overweight: a randomized controlled trial. Avicenna J Nurs Midwifery Care. 2021;29(2):102–12.
42. Baji Z, Baesi A, Shakerinejad G, Tehrani M, Hajinajaf S, Jarvandi F. The effect of education based on health belief model on eating| behaviors and weight control on female high school students in ahwaz. Iran J Health Educ Health Promot. 2018;6(3):231–40.
43. Diddana TZ, Kelkay GN, Dola AN, Sadore AA. Effect of Nutrition Education Based on Health Belief Model on Nutritional Knowledge and Dietary Practice of Pregnant Women in Dessie Town, Northeast Ethiopia: A Cluster Randomized Control Trial. J Nutr Metab. 2018;2018:6731815.
44. Yahyavi SH, Pourrahimi M. Impact of dietary behaviors and exercise activities education on the self-efficacy of middle school students. Med Sci J Islamic Azad Univesity-Tehran Med Branch. 2012;22(2):143–51.
45. Tavakoli HR, Dini-Talatappeh H, Rahmati-Najarkolaei F, Fesharaki MG. Efficacy of HBM-based dietary education intervention on knowledge, attitude, and behavior in medical students. Iran Red Crescent Med J. 2016;18(11):e23584.
46. Odiwuor F, Kimiywe J, Waudo J. Effectiveness of nutrition education on nutrient intake and pregnancy outcomes in MIGORI COUNTY, WESTERN KENYA. Afr J Food Agric Nutr Dev. 2022;22(1):19271–84.
47. Araban M, Baharzadeh K, Karimy M. Nutrition modification aimed at enhancing dietary iron and folic acid intake: an application of health belief model in practice. Eur J Pub Health. 2017;27(2):287–92.
48. Hasneezah H, Rosliza A, Salmiah M, Appanah G. The effectiveness of theory-based intervention to improve haemoglobin levels among women with anaemia in pregnancy. Med J Malaysia. 2020;75(6):626–34.
49. Aghapour B, Rashidi A, Dorosti-Motlagh A, Mehrabi Y. The association between major dietary patterns and overweight or obesity among Iranian adolescent girls. Iran J Nutr Sci Food Technol. 2013;7(5):289–99.
50. Jolliffe DM, Mahler DG, Lakner C, Atamanov A, Tetteh Baah SK. Assessing the Impact of the 2017 PPPs on the International Poverty Line and Global Poverty. 2022.
51. Darmon N, Drewnowski A. Does social class predict diet quality? Am J Clin Nutr. 2008;87(5):1107–17.
52. Kunst AE, del Rios M, Groenhof F, Mackenbach JP. Socioeconomic inequalities in stroke mortality among middle-aged men: an international overview. Stroke. 1998;29(11):2285–91.
53. Kunst AE, Leon DA, Groenhof F, Mackenbach JP. Occupational class and cause specific mortality in middle aged men in 11 European countries: comparison of population based studiesCommentary: Unequal inequalities across Europe. BMJ. 1998;316(7145):1636–42.
54. Saurel-Cubizolles M-J, Chastang J-F, Menvielle G, Leclerc A, Luce D. Social inequalities in mortality by cause among men and women in France. J Epidemiol Community Health. 2009;63(3):197–202.

Publisher's Note