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Effectiveness of Community-based Intervention to Promote Iran's Food-based Dietary Guidelines

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Date of Submission: Aug 21, 2011

Date of Acceptance: Oct 04, 2011

How to cite this article: Shariatjafari S, Omidvar N, Shakibazadeh E, Majdzadeh R, Minaei M, Gholamzade M. Effectiveness of community-based intervention to promote Iran's food-based dietary guidelines. Int J Prev Med 2012;4:249-61.

Original Article

ABSTRACT

Background: Dietary Guidelines are considered as a useful tool for the promotion of healthy dietary behaviors. In Iran, despite the development of the latest National Food-Based Dietary Guidelines, in 2006, it has not been introduced at the community level yet. The present study aims to evaluate the effectiveness of an intervention program to promote Iran's Food-Based Dietary Guidelines (IFBDGs) in urban adult women.

Methods: A sample of 435 healthy women, aged 26 to 54 years, was randomly assigned to the intervention or control groups. The intervention group was designed based on the Health Belief Model (HBM). Each subject in the intervention group received three sessions of group education on IFBDGs and the food guide pyramid and participated in a healthy cooking class. Dietary intake, cognitive outcomes related to the constructs of the HBM, physical activity, and the BMI were measured in both groups before, immediately, and one month after the intervention. The outcome measures were compared with the analysis of covariance (ANCOVA), by adjusting for baseline values.

Results: The intervention group had a significantly lower total daily energy intake than the control group after the intervention (P=.000). The adjusted differences in the changes of body mass index from the baseline were significant in both post intervention measurements in the intervention group compared to the controls.

Conclusions: The intervention designed based on the Health Belief Model was effective in improving the adherence to FBDGs and could serve as a basic model for the promotion of healthy nutrition behavior among women in the primary health care setting.

Keywords: Community-based trial, food-based dietary guidelines, health belief model, Iran, urban women

INTRODUCTION

Food-based Dietary Guidelines (FBDGs) have been proposed by theWorld Health Organization (WHO) as a convenient tool for nutrition education to the public and individuals. These educational tools provide practical guidance that can lead to improved dietary behavior, public health, and reduce the costs of nutrition-related chronic diseases.[1] Based on the latest study on nutrition transition in Iran by Ghassemi and colleagues,[2] there is considerable imbalance in food consumption with low nutrient density characterizing diets at all income levels, over-consumption evident among more than a third of the households, and food insecurity among 20% of the population. Obesity is an emerging problem, particularly in urban areas and in women; and both diabetes and other risk factors for heart disease are becoming significant problems.

The latest edition of Iran's Food-based Dietary Guidelines was developed in 2006, with a partnership between the National Office of Nutrition Improvement, Iranian Nutrition Society and the WHO regional office. However, the guidelines have not been introduced at the community level yet. Experiences of other countries on the promotion of FBDGs have shown that they can be effective in the prevention of chronic diseases and improvement of public health in community-based programs. In countries with longer experience of implementing dietary guidelines, such as Germany and New Zealand, positive changes have been observed in behaviors related to food consumption, through extensive dissemination of training manuals in the educational system and primary health care, as well as the Internet.[3]

According to the WHO and Food and Agriculture Organization (FAO) recommendations, the key to achieving stable behavioral changes in food choices through dietary guidelines is to engage different sections of the community and use effective education policies and strategies in different groups of the society.[3-6] Moreover, designing such programs requires the understanding of factors that shape behavior related to food choices.[7] Studies on determinants of food choices in western countries have shown factors such as taste preference, habits, and price as the most important ones; while social and psychological research, suggest that variables such as self-efficacy, attitudes, and beliefs are the determining factors that need to be taken into consideration.[8]

Behavioral change theories and models attempt to explain the reasons behind alterations in individuals' behavioral patterns. It is well-established that interventions informed by well-developed and tested theories are more effective in changing behavior than those not based on theories. Moreover, using constructs of theories helps researchers to compare findings across studies to identify the influential factors.

The Health belief model (HBM) is one of the theories widely used as the theoretical framework in nutrition interventions.[7,9,10] Based on this model, an individual's perception of a topic related to health can lead to movement and motivation that results in a person's behavioral change. Generally, this model focuses on changes in beliefs and proposes that by changes in beliefs, a stable change in behavior can occur. According to this model, to take preventive actions, people must first feel threatened against the issue (perceived susceptibility), then understand the depth and seriousness of the risk of complications in the physical, psychological, social, and economic dimensions (perceived severity), and on receiving positive signs of their indoor environment (Cues to action), must believe the useful aspect of these preventive actions (perceived benefits) and eventually find out that the benefits of following these guidelines cost less than the factors inhibiting the implementation of these Directives (perceived barriers).[9,10] However, unfortunately, few studies have investigated the effect of cognitive factors in shaping health-and nutrition-related behaviors.[8,11] This limitation in designing community-based trials has been the result of ineffective behavior-change interventions. Accordingly, designing and running a community-based intervention program aimed at implementation of IFBDGs in the community level, was raised as required by the Nutrition Department of the Ministry of Health and Medical Education of Iran.

The aim of the present study was to design an educational program to promote Iran's food-based dietary guidelines and to assess the effectiveness and feasibility of the program in healthy adult women. The program used the HBM as a theoretical framework. The nutrition education program was designed as an initial prototype to aid in health and nutrition promotion within the primary health care system in the country.

METHODS

Intervention

The intervention consisted of a standardized food skills and nutrition education program on IFBDGs, which was designed based on the HBM [Table 1]. The four sessions of the educational program was delivered over four weeks in 12 urban health centers in the north of Tehran, Iran. The fourth session included a group cooking class in which they observed the actual preparation of a high-fiber, low-fat salad. It was intended to increase healthy cooking confidence and promote the consumption of dietary fiber, vegetables, beans, fish, and low-fat in the target group.

Table 1: Overview of the nutrition intervention

Session	Topic	Content
1	National food pyramid and food groups	Major food groups, the structure of the food pyramid and its application to set a proper diet and the amount of food servings that everybody needs, the importance and necessity of each food group
2	Iranian food-based dietary guidelines, (The first five guidelines)	Definition and importance of IFBDGS as an effective educational tool for diet planning and health promotion, the prevalence of chronic diseases associated with eating habits, effects of a balanced lifestyle and physical activity, weight control practices (obstacles and cues to actions), the concept of the dietary fiber and its role in providing health, increase daily fiber intake, role of low-fat dairy products on health, and suggestions for increasing consumption of low-fat dairy products
3	Iranian food-based dietary guidelines, (The second five guidelines)	Types of fats and their role in health, improving the consumption of fat (reduced fat consumption approach), definition of different types of meats and their role in health provided practical advice on reducing red meat consumption and industrial products, with increased consumption of fish, reduced intake of mono- and disaccharides, reduced salt intake, six to eight glasses of water daily
4	Healthy cooking (Skill-building)	Common unhealthy eating habits, the best way to cook food, and cooking low-calorie food, with high-fiber and known by the target group in the urban health center

An overview of the nutritional intervention is presented in Figure 1, which shows the topics and content, and how constructs of the HBM are integrated into each session of the program. In each health center, two trained health workers provided all the instruction. Tailoring of the intervention was also based on the baseline measurement, prior research findings, and the HBM constructs.

Training the trainers

The trainers in this program were the health workers in the designated health centers, thus Training of the Trainers (TT) was the approach taken to prepare them. Training of the health workers was performed by two nutritionists (SS and NO), in a two-day workshop. Through this workshop, the health workers were trained on the objectives and content of Iran's IFBDGs and food guide pyramid, as well as the techniques to manage the classes in the intervention health centers. The efficacy of the educational process was measured with pre-test and post-test questionnaires at the beginning and end of the workshop.

Recruitment of subjects

After coordination with the health centers, the health volunteers were asked to invite eligible women to participate in the educational program. In each health center, 40 women aged 26 to 59 years, who met the inclusion criteria, were enrolled. A sample size of 180 was estimated, to provide 80% power at an alpha level of 0.05 to detect R^2 of .25, for a variable in each group.[12] A random sample of 426 healthy women was enrolled in 12 urban health centers of the Shahid Beheshti University in northern Tehran (districts 3, 4, 7, and 8), based on their population.

Criteria for exclusion were: (a) Presence of any diseases and disorders that cause a change in lifestyle or diet, including: Cancer, diabetes, cardiovascular disease, disability, musculoskeletal disorders, and respiratory distress; (b) being on a special diets, including a weight-loss diet during the study; (c) Pregnancy or lactation; (d) Older than 59 or younger than 26 years, and (e) Residence in non-covered areas.

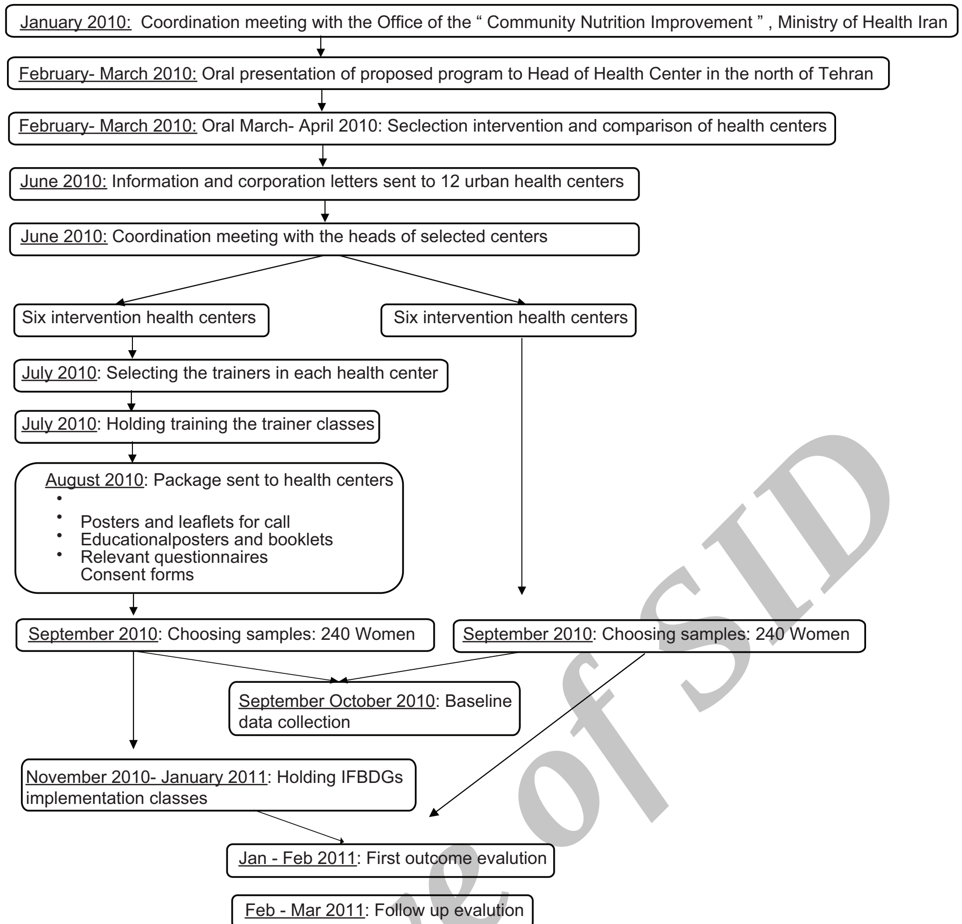

Figure 1: Process used for contacting health centers, implementation of intervention and data collection

Data collection and instrumentations

A questionnaire was used at baseline and post-intervention to evaluate the dietary intake and behavioral determinants based on the HBM. The questionnaire was completed through an interview, and each interview took between 30 and 45 minutes. The two sections of the questionnaire included:

Section I: The dietary behaviors of women were assessed using 24-hour diet (24-h recall) Recalls, which were asked by a member of research team from the target group. Subsequently, after adjusting the 'over report/underreport fraction' for total energy intake, the data was used to measure the status of dietary intake. Food analyses were performed using the nutritionist IV software and the Healthy Eating Index (HEI) was extracted as the main outcome.[13-15] Portion size was noted based on USDA food guide pyramid guidance.[15]

Section II: Assessment of HBM constructs, as they relate to dietary guidelines, was done by a self-administered questionnaire. Due to the lack of tools in the published literature that addressed all specific project goals [Table 2], a self-made questionnaire was specifically developed through the results of a review of the literature, consultation, and focus group discussion (FGD).

An expert panel was used to determine the content validity of the questionnaire. For this purpose, the questionnaire was sent with assessment tables to 11 specialists in the areas of Health Education and Nutrition Sciences. They were asked about the content validity ratio (CVR) or the necessity of subject and content validity index (CVI) or relation to the subject of each question. The CVR minimum acceptable score for each question was considered to be 0.59 and the minimum acceptable score for CVI was equal to 0.79.[16,17] After analyzing the results, the CVR score for less than 27 questions was acceptable and for CVI only two questions were in the unacceptable range.

Table 2: The seven specific constructs of the HBM questionnaire

HBM constructs	Number of items	Key measures
Knowledge	9	Women's knowledge and education level associated with IFBDGs
Perceived susceptibility	10	The amount of vulnerability or being at risk a person considered herself to be in, as a result of unhealthy eating habits
Perceived severity	6	Risks resulting from improper eating behaviors
Perceived benefits	10	Benefits resulting from performing healthy eating behavior
Perceived barriers	14	Barriers against healthy eating behaviors at family or society levels
Self-efficacy	10	The amount of self-confidence and power that a person feels with respect to healthy eating behaviors
Individual factors	6	Demographics

Evaluation of the face validity of the questionnaire was conducted based on the comments of the expert panel members, including wording, emotional expression, and removing duplicates. Results from this level were checked with two members of the panel (the reason of choosing them was because they were knowledgeable about the subject and had more active participation in the Feedback forms). The final revised questionnaire had accepted 58 questions.

Reliability and repeatability of the questionnaire were tested using a test–retest design with a three-week interval between measurements. Valid data were collected from 30 women, who had demographic situations similar to the target group. We used the Intraclass Correlation Coefficient (ICC) statistics. The ICC minimum acceptable score for each question was considered to be 0.6.[18,19] After analyzing the questionnaire, the ICC scores for question numbers 4, 12, 19, and 52 were insignificant. On account of the essential need for these four questions, after fixing the face of the questions and checking with the expert panel, these questions remained in the final questionnaire, but in the data gathering phase, extra explanation was given to target group about these questions.

Section III: Anthropometric measurements, Height, and Weight were measured and BMI was calculated.[20]

Statistical analysis

Urban health centers were randomly assigned to the intervention group or the control group by a member of the IFBDGs program. Participants for whom there was no data on their outcome evaluations were excluded from the study. Differences between the groups for baseline variables were assessed by an independent sample *t*-test and Chi-square analysis. The paired *t*-test was used to examine changes in dietary intake and physical activity from the baseline, to immediately after intervention. Changes in the BMI and HBM constructs were compared using the ANCOVA by adjusting for baseline values.

All tests for significance were two-sided with a 5% significance level. All statistical analysis was performed using the SPSS version 16 for windows (S Inc., Chicago IL).

RESULTS

Of the 480 women who participated, 45 subjects (19, intervention group; 26, control group) could not attend the follow-up measurements and were excluded from the study. Four hundred and thirty-five subjects (90.6%) (221, intervention group, 213, control group) completed the baseline, post test, and follow-up questionnaires.

Demographic characteristics of the intervention and control groups at baseline are presented in Table 3. No significant differences were observed between the two groups at the baseline.

Dietary intake

As shown in Table 4, the difference in the change from baseline in the absolute value for total energy intake was adjusted for over/under-reporting; and a significant reduction in the intervention group was observed (−232.99, 95% CI −334.07 to −131.92, P=.000). Also, after the intervention, the percentage of total energy from the total fat (−5.19%, 95% CI −7.26% to −3.11%, P=.000), as well as the daily sodium (mg) intake (−1240.45, 95% CI −1394.86 to −1086.04, P=.000) was significantly decreased in the intervention

Table 3: Baseline demographic characteristics of the participants who completed a one-month follow-up

Variables	Intervention group *n*=221	Control group *n*=213	*P* value
Age (year)	38.75 ± 9.35	41.68 ± 9.79	.740
Income (rials)	6576697 ± 4152252	5879907 ± 3901741	.405
Family size (person)	3.81 ± 1.14	3.98 ± 1.23	.864
Education level			
Illiterate/low literacy	14 (3.2)	24 (5.5)	.259
Under diploma	48 (11)	46 (10.6)	
Diploma	110 (25.3)	106 (24.4)	
Upper diploma	49 (11.3)	38 (8.7)	
Marital status			
Married	205 (47.1)	197 (45.3)	.958
Single	12 (2.8)	13 (3)	
Widow/divorced	4 (.9)	4 (.9)	
Job status			
Homemaker	187 (43)	185 (42.5)	.779
Employed	32 (7.4)	28 (6.4)	
Retired	2 (.5)	1 (.2)	
Husband's job status			
Retired	20 (4.6)	22 (5.1)	.137
Employed	187 (43)	179 (41.1)	
Unemployed	1 (.2)	6 (1.4)	

Data are mean±SD and *n* (%)

group; while, a significant increase in sodium intake in the control group was observed over the same period (346.45, 95% CI 136.48 to 556.43, *P*=.001).

Servings of red meat consumption increased in the control group after the intervention (.415, 95% CI .239 to .591, *P*=.001); while it decreased in the intervention group, but it was not statistically significant. In both the intervention and control groups, consumption of processed meat significantly decreased (−.080, 95% CI −.149 to −.011, *P*=.023 and −.070, 95% CI −.122 to −.018, *P*=.008, respectively). Likewise, daily servings of nuts, legumes, and low fat dairy increased in the intervention group (.075, 95% CI.025 to .124, *P*=.003 and .298, 95% CI.147 to .448, *P*=.000, respectively). Surprisingly, after the intervention, the total Dairy intake and Dietary diversity score decreased significantly in the intervention group.

On the other hand, at the end of the study, in the control group, decreases in daily intake of vegetables (−.678, 95% CI −1.09 to −.263, *P*=.002) was observed, while water consumption significantly increased in both the intervention and control groups (.406, 95% CI .075 to .737, *P*=.017 and .789, 95% CI. 171 to 1.40, *P*=.013.

Health beliefs

Among the HBM constructs, perceived severity and perceived barriers were significantly different between the two groups at baseline, and the adjusted differences in the score change of these constructs were also significantly different before the intervention (.757, 95% CI .411 to 1.104, *P*=.000 and 4.979, 95% CI 3.468 to 6.489, *P*=.000; respectively) and remained higher after the one month evaluation in the intervention group (.707, 95% CI .277 to 1.137, *P*=.000 and 4.764, 95% CI 2.904 to 6.625, *P*=.000; relatively).

Other constructs of HBM, were not statistically different at baseline; however, after the intervention and after a one-month follow-up, all the constructs improved in the intervention group [Table 5].

Knowledge

Score for knowledge was significantly different between the two groups at the baseline. After intervention, the adjusted differences (for baseline score) in the score of changes were statistically significant in both the outcome evaluations in the intervention group (1.54 ± .152, 95% CI 1.179 to 1.913, *P*=.000 and 1.61 ± .149, 95% CI 1.251 to 1.971; relatively) [Table 5].

Physical activity and BMI

Over the period of intervention, an increase in physical activity duration was observed in the intervention group (5.36 ± 1.845; *P*=.004), but no changes were observed in the frequency of physical activity in both groups [Table 6].

Based on Table 7, the adjusted differences in the changes in BMI from baseline were significant in both the measurement phases in the intervention group (−.183, 95% CI −.286 to −.079, *P*=.000 for the first outcome evaluation and −.372, 95% CI −.506 to −.237, *P*=.000 for the 'after one month' evaluation).

DISCUSSION

This community-based trial on the promotion of

Table 4: Dietary intake of women who participated in the IFBDGs implementation program before and after intervention

Variable	Before intervention mean±SD	After intervention mean±SD	Paired differences			*P* value
			Mean differences±SE	95% confidence interval of the difference		
				Lower	Upper	
Energy intake, Kcal[1]						
Control	1534.38 ± 464.94	1587.54 ± 448.32	44.16 ± 40.93	−36.66	124.98	.282
Intervention	1655.98 ± 586.52	1422.98 ± 397.90	−232.99 ± 51.17	−334.07	−131.92	.000
P value	.033	.027				
Energy from fat, % of total energy Kcal						
Control	31.85 ± 9.31	31.71 ± 8.48	−.144 ± .945	−2.01	1.72	.879
Intervention	33.93 ± 10.02	28.74 ± 10.02	−5.19 ± 1.05	−7.26	−3.11	.000
P value	.103	.564				
Energy from saturated fat, % of total energy Kcal						
Control	8.63 ± 3.64	12.28 ± 30.80	3.65 ± 2.38	−1.05	8.37	.128
Intervention	10.07 ± 4.01	9.15 ± 5.27	−.916 ± .506	−1.91	.082	.072
P value	.258	.267				
Cholesterol intake, mg						
Control	164.35 ± 125.20	164.42 ± 120.13	.069 ± 12.20	−24.03	24.17	.995
Intervention	182.95 ± 127.08	180.50 ± 139.61	−2.44 ± 13.14	−28.40	23.50	.852
P value	.926	.060				
Sodium intake, mg						
Control	2816.67 ± 628.52	3163.13 ± 1234.42	346.45 ± 106.35	136.48	556.43	.001
Intervention	3212.37 ± 791.72	1971.92 ± 618.81	−1240.45 ± 78.18	−1394.86	−1086.04	.000
P value	.011	.159				
Red meat intake, ser./day[2]						
Control	.576 ± .742	.992 ± .912	.415 ± .089	.239	.591	.000
Intervention	.768 ± .874	.705 ± .742	−.062 ± .084	−.103	.229	.458
P value	.003	.038				
White meat intake, ser./day						
Control	.437 ± .571	.476 ± .781	.039 ± .069	−.098	.177	.571
Intervention	.596 ± .892	.634 ± .865	.038 ± .098	−.232	.156	.699
P value	.000	.008				
Fish intake, ser./day						
Control	.068 ± .248	.075 ± .317	.006 ± .027	−.048	.062	.804
Intervention	.038 ± .193	.078 ± .292	.039 ± .026	−.091	.012	.134
P value	.018	.954				
Poultry intake, ser./day						
Control	.368 ± .556	.401 ± .755	.032 ± .067	−.099	.165	.626
Intervention	.557 ± .888	.556 ± .846	−.001 ± .097	−.190	.193	.982
P value	.000	.004				
Processed meat intake, ser/day						
Control	.098 ± .278	.027 ± .183	−.070 ± .026	−.122	−.018	.008
Intervention	.112 ± .402	.031 ± .161	−.080 ± .034	−.149	−.011	.023
P value	.287	.710				
Beans and nuts intake, ser./day						
Control	.178 ± .279	.204 ± .314	.025 ± .032	−.090	.038	.430

(Continued)

Table 4: (Contd...)

Variable	Before intervention mean±SD	After intervention mean±SD	Paired differences			*P* value
			Mean differences±SE	95% confidence interval of the difference		
				Lower	Upper	
Intervention	.129 ± .209	.204 ± .275	.075 ± .025	.025	.124	.003
P value	.017	.036				
Total grain intake, ser./day						
Control	5.82 ± 2.78	6.19 ± 2.90	.362 ± .307	−.243	.969	.239
Intervention	5.18 ± 2.89	5.26 ± 2.24	.077 ± .250	−.571	.416	.757
P value	.917	.015				
Whole grain intake, ser./day						
Control	2.75 ± 2.21	2.49 ± 2.75	−.252 ± .276	−.798	.294	.364
Intervention	1.97 ± 2.42	2.04 ± 2.21	.073 ± .225	−.519	.371	.745
P value	.928	.476				
Total dairy intake, ser./day						
Control	1.30 ± 1.12	1.39 ± 1.46	.089 ± .155	−.216	.39626	.563
Intervention	1.51 ± 1.28	1.47 ± 1.24	−.040 ± .119	−.195	.275	.738
P value	.417	.832				
Low-fat dairy intake, ser./day						
Control	.26 ± .567	.244 ± .59	−.016 ± .058	−.132	.098	.773
Intervention	.44 ± .762	.745 ± .89	.298 ± .076	−.448	−.147	.000
P value	.000	.000				
Fruit intake, ser./day						
Control	1.89 ± 1.58	2.05 ± 1.72	.155 ± .176	−.192	.503	.378
Intervention	1.98 ± 1.67	2.04 ± 1.36	.059 ± .135	−.326	.207	.661
P value	.178	.054				
Vegetable, ser./day						
Control	2.94 ± 2.14	2.26 ± 1.99	−.678 ± .210	−1.09	−.263	.002
Intervention	2.69 ± 1.73	2.69 ± 1.82	.004 ± .192	−.385	.376	.982
P value	.042	.041				
Water intake, glass/day						
Control	3.81 ± 2.56	4.60 ± 3.38	.789 ± .313	.171	1.40	.013
Intervention	4.45 ± 2.62	4.85 ± 2.49	.406 ± .167	.075	.737	.017
P value	.917	.445				
Dietary diversity DDS						
Control	7.98 ± 2.16	7.64 ± 2.38	−.324 ± .244	−.806	.158	.186
Intervention	8.54 ± 2.41	8.87 ± 2.50	.331 ± .214	−.092	.754	.124
P value	.338	.669				

[1]Values are unadjusted means (SEMs). There are six health centers and 221 women in the intervention group and six health centers and 184 women in the control group. [2]Serving size was noted based on the USDA food guide pyramid guidance

IFBDGs, which is the first of its type in the country, showed that the designed intervention based on the HBM, was effective and led to a significant improvement in women's individual perception about IFBDGs, and resulted in some positive behavioral changes, including decrease in daily consumption of energy, sodium, saturated fats, as well as red and processed meat, and an increase in the daily intake of low-fat dairy, legumes, and nuts. Also, an increase in the mean daily physical activity and decrease in BMI were observed.

Despite numerous evidences of the predictive power of HBM regarding health-related behaviors,[21] interventions that have been applied in this

Table 5: Percent changes in HBM constructs from baseline to one month after implementation of the IFBDGs program in the intervention and control groups

Variable*	Baseline (before) mean±SD	First outcome evaluation (after) mean differences±SE (from baseline)				First follow-up (after one month) mean differences±SE (from baseline)			
		mean±SE	CI 95% Lower bond	CI 95% Upper bond	ANCOVA *P* value[c]	mean±SE	CI 95% Lower bond	CI 95% Upper bond	ANCOVA *P* value
Knowledge									.000
Intervention	5.71 ± 1.61	1.54 ± .152	1.179	1.913	.000	1.61 ± .149	1.251	1.971	
Comparison	5.55 ± 1.61	−.027 ± .095	−.258	.205		−.124 ± .090	.513	−.342	
P value[a]	.777								
Perceived susceptibility									.000
Intervention	44.15 ± 4.43	2.71 ± .329	1.918	3.511	.000	3.13 ± .338	2.317	3.955	
Comparison	44.25 ± 4.31	−.779 ± .193	−1.247	−.311		−.071 ± .221	−.608	.467	
P value	.786								
Perceived severity									.000
Intervention	28.45 ± 1.94	.757 ± .143	.411	1.104	.000	.707 ± .177	.277	1.137	
Comparison	27.62 ± 3.08	−.513 ± .126	−.819	−.208		−.478 ± .222	−1.018	.062	
P value	.038								
Perceived benefits									
Intervention	45.94 ± 3.21	1.979 ± .269	1.327	2.630	.000	2.129 ± .306	1.388	2.870	.000
Comparison	46.46 ± 3.43	−.991 ± .181	−1.431	−.551		−1.053 ± .189	−1.513	−.593	
P value	.293								
Perceived barriers									
Intervention	50.61 ± 9.39	4.979 ± .623	3.468	6.489	.000	4.764 ± .768	2.904	6.625	.000
Comparison	48.79 ± 10.40	.434 ± .447	−.652	1.519		−.283 ± .401	−1.258	.692	
P value	.039								
Self efficacy									
Intervention	42.29 ± 6.98	4.507 ± .522	3.243	5.772	.000	4.771 ± .560	3.415	6.128	.000
Comparison	43.15 ± 5.73	−1.150 ± .229	−1.722	−.579		−619 ± .147	−.976	−.263	
P value	.49								

*There were six health centers and 221 women in the intervention group and six health centers and 213 women in the control group. [a]*P* values were derived by independent sample *t*-test for normal distributed variables and the Mann-Whitney U test was used for the non-parametric data. [b]*P* values were derived by repeated measures of ANOVA, adjusted by the time of measurement. [c]Adjusted for baseline value by ANCOVA

theory are limited. This model emphasizes on the perception of the subjects that leads to motivation and changed behavior in a person. Generally, this model focuses on changes in beliefs, and changes in beliefs can lead to changes in health-related behaviors.[10] Webb and colleagues[22] confirmed the efficacy of the basic principles of operation of the HBM including perceived susceptibility, severity, benefits and barriers, and self-efficacy.

Iran, is a country in the middle of an accelerated nutrition transition,[2] with a rapid increase in the prevalence of non-communicable diseases, where planning of health promotion to improve health behaviors is a priority. Despite this, there is not enough information about the most effective intervention strategies in different population groups. Results from several studies, show that the impact of community-based nutrition interventions in different communities is low to moderate.[22]

The effect of our intervention on the HBM constructs in both post-intervention measurements indicated improvement when compared with the pre-intervention phase. The effect size of the intervention on these structures, in both measures, was moderate. The highest changing

Table 6: Results of physical activity in women who participated in the IFBDGs implementation program before and after intervention

Variable[1]	Before intervention mean±SD	After intervention mean±SD	Paired differences			*P* value
			Mean differences±SE	95% confidence interval of the difference		
				Lower	upper	
Frequency of physical activity, time/week						
Control	2.48 ± 2.619	2.34 ± 2.652	−.144 ± .192	−.52408	.23604	.456
Intervention	2.81 ± 2.853	2.90 ± 2.967	.081 ± .198	−.30923	.47212	.682
P value	.005	.000				
Duration of physical activity, minutes/day						
Control	23.66 ± 27.115	21.26 ± 26.410	−2.40 ± 2.481	−7.29815	2.49380	.334
Intervention	23.32 ± 25.158	28.68 ± 30.299	5.36 ± 1.845	1.72547	8.99852	.004
P value	.251	.072				

[1]Values are unadjusted means (SEMs). There were six health centers and 221 women in the intervention group and six health centers and 184 women in the control group

Table 7: Percentage of changes in the body mass index from baseline to one month after implementation of the IFBDGs program in the intervention and control groups

Variable	Baseline (before) mean±SD	First outcome evaluation (after) mean differences±SE (from baseline)				First follow-up (after one month) mean differences±SE (from baseline)			
		Mean±SE	CI 95%		ANCOVA *P* value[c]	Mean±SE	CI 95%		ANCOVA *P* value
			Lower bond	Upper bond			Lower bond	Upper bond	
BMI					.000				.000
Intervention	27.853 ± 4.418	−.183 ± .043	−.286	−.079		−.372 ± .056	−.506	−.237	
Comparison	27.914 ± 4.407	.073 ± .036	−.016	.161		.376 ± .039	.280	.472	
P value[a]	.816								

*There were six health centers and 221 women in the intervention group and six health centers and 213 women in the control group. [a]*P* values were derived by independent sample *t*-test for normal distributed variables and the Mann-Whitney U test was used for non-parametric data. [b]*P* values were derived by repeated measures ANOVA, adjusted by time of measurement. [c]Adjusted for baseline value by ANCOVA, BMI - Body mass index

score was for perceived barriers (4.789 ± 0.633) in the intervention group. This is in concordance with Janz *et al.*,[23] and Hollis and colleagues,[24] who have shown perceived barriers to be the most powerful construct in this model, which has the best correlation with preventive health behaviors.

Hajian *et al.*,[25] also showed that after applying their trial, all the HBM constructs, except of perceived barriers, increased significantly. They concluded that in order to reduce perceived barriers in a community-based trial, they had to help people to mitigate with and eliminate obstacles that grapple with them and reform the strategies associated with them. Based on HBM, behavior change occurred through changes in beliefs, as also through beliefs and convictions rooted in the social-cognitive determinants. Thus, the above-mentioned factors could cause behavioral changes.[26-28]

Interventions have been effective in promoting public awareness among people, but increasing awareness will not necessarily lead to behavior changes in people.[29] In the present study, despite the positive impact of the intervention on target dietary behaviors, the impact of the intervention is relatively low on all aspects of dietary intake, except for daily water consumption. Based on Webb,[22] moderate-to-large changes in intention can result in small-to-moderate changes in behavior. In this case, the moderate effect on women's beliefs (HBM constructs) has led to a small effect on the dietary intake.

As first and second outcome evaluations were held during fall and winter, seasonal changes may explain some of the results. For example, lack of any significant increase in fruit and vegetable consumption may be due to a decrease in the variety and reduced access, or increase in price of the fruits and vegetables in winter compared to fall.

Manois and colleagues,[12] in a clinical trial, aimed to assess the effectiveness of a Nutrition Education Program, based on HBM and Social Cognitive Theory (SCT), on post-menopausal women using self-reported nutrient intake. women using self-reported nutrient intake data, as well as a qualitative data obtained by the Healthy Eating Index (HEI). Based on results, the data showed that dairy intake and HEI score increased and energy from total fat and sodium intake decreased significantly, because of the physiological conditions of the participants. The risk of osteoporosis was considered more critical, so a significant intervention effect was on calcium and vitamin D intake. Another interventional study,[30] with an approach based on behavior change using HBM, aimed at reducing fat intake and increasing fruits and vegetables was done. This also led to a significant reduction in total fat and saturated fat intake in the intervention group, but changes in intake of fruits and vegetables were not statistically significant.

Marcus and colleagues,[31] in an intervention that aimed to promote fruit and vegetable consumption in healthy adults, based on the HBM, found that after the intervention and one year after the intervention, there was a significant increase in fruit and vegetables consumption. The result of this study was due to the success in planning the promotion of vegetables and fruits, using methods such as phone calls and e-mail support in addition to training and skill building. Also, the results of a study,[32] which aimed to implement dietary guidelines in the United States, indicated a significant increase in the intake of grains, vegetables, and dairy products.

Comparison between the duration of physical activity (minutes/day), from pre-intervention to follow-up after the intervention, showed that the intervention group has been more active. The frequency of physical activity (times/week) showed no significant differences between the two groups.

The results of a study by Osborn and colleagues,[33] based on theories of behavior change (IBM: Information-Motivation-Behavioral Skills), which aimed to promote physical activity and behavior change skills in patients with type 2 diabetes, found that the interventions increased the duration, intensity, and frequency of physical activity in the intervention. However, in this research the instrument to measure the intensity of physical activity was not defined, so changes in the physical activity level of the target group was based on a question. Other interventions based on the HBM, were in line with the findings of our study. The overall strategy to promote physical activity was sorted into three classes: Skill-building, creating supportive environments, and methods of support and encouragement.[34,35] The proposed strategy utilized three levels, which had the highest effect on increasing the duration and intensity of physical activity.[36]

Previous short-term community-based interventions conducted in various communities, aimed at improving nutritional status with emphasis on weight control and energy intake have also reported a significant reduction in body weight of the participants[37-39]. However, in some cases the weight lost has not been maintained after intervention for a long time[38]. In our study, due to the short interval between the first and second measurements, it is not as accurate to judge the effect of intervention on the weight loss maintenance..

Results from the review article of Sahyoun and colleagues[21] showed that community intervention that had positive effects on behavioral changes usually included limiting educational messages to one or two; reinforcing and personalizing messages; providing hands-on activities, incentives, cues, and access to health professionals; and using appropriate theories of behavior change. Based on this article, the participants that perceived themselves as more vulnerable about a health-related behavior, showed a better response to the interventions.

This study was the first conducted in Iran, to implement Iranian food-based dietary guidelines at the community level. However, several limitations occurred that should be considered in the analysis of the findings. First, the study was held among women who were covered by health centers in northern Tehran. Based on the findings of the study as well as from the women, it was gathered that wives and children (especially sons) have an effective role in shaping the behavior of food choice habits at the household level. Therefore, we cannot intervene in the women's lives, expecting to obtain the final result and the full implementation of IFBDGs in the community and families in Iran. Second, due to time constraints, possible interventions were held for a short period and long-term effects of interventions is not clear. Thirdly, the measured variables were based on self-reporting. In using this method, recall and social desirability bias may have effect on the participants' response.[40]

Results of this study showed that the educational intervention designed based on the HBM, can be effective to promote compliance with the dietary guidelines in the participants, and can lead to a significant change in the participants' perceptions and beliefs. However, these effects were not identical in all aspects of dietary habits.

The educational tools that are designed to facilitate the implementation of guidelines during the intervention must be cheap, simple, and intelligible, in order to implement the guidelines.

ACKNOWLEDGMENT

We wish to express our sincere thanks and appreciation to the Head of the Nutrition Department, Ministry of Health and Medical Education and North Khorasan province deputy of health for supporting the project. We would also like to thank the Horizan International Tourism Training Institute and Tour and Travel Agency Institute, and colleagues Ms. Hamideh Sharif and Soudabeh Fakharzadeh for helping in the project by conducting cooking classes. We also thank the Head and personnel of the health center of northern Tehran, and all the women who participated in this study. We thank Ms. Elnaz Khosravi and Mona Jonoush for helping us in data gathering.

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Source of Support: Nil, **Conflict of Interest:** None declared.