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The Effectiveness of Nutritional Interventions Based on Health Education and Promotion Theories and Models: A Systematic Review

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ABSTRACT

Background: The content of nutrition education and the process of behavioral change should be designed based on the principles of educational for achieving behavioral goals. This systematic study aimed to evaluate the effectiveness of nutrition interventions designed mainly by health educational and promotional theory and models. **Methods:** The PubMed, Science Direct, Scopus, and Cochrane databases were searched using the following keywords "nutrition behavior" or "food behavior" or "dietary behavior" and "model" or "theory" and "intervention" or "predict" from 2013 up to April 2018 in English Language. **Results:** Regarding the inclusion criteria, 25 interventional studies were assessed of 3090 primary screened investigations. Social Cognitive Theory, Empowerment model, Theory of Planned Behavior, and Health Belief Model were mostly used in the investigated studies. Most target groups in these studies were school students and women. In the field of constructs, self-efficacy and attitude mainly applied in studies seem to be the most important for researchers. In the field of educational methods, group educational methods in the forms of lectures, group discussions, and brainstorming were mainly applied by researchers. **Conclusion:** To change eating behaviors, the study framework, duration of training, and correct training method should be designed according to the target group as well as appropriate theory and models.

Keywords: *Theory; Model; Intervention; Nutrition*

Introduction

Nutrition is an important factor in providing health and developing illness. People's nutrition status determines the health condition of society (Coffey *et al.*, 2018). Food patterns are different among various people with diverse sorts of socioeconomic statuses, races, communities, and cultures. Meanwhile, the socio-economic development of every society is associated directly with people's nutrition status (Jessri *et al.*, 2011). Poor nutrition pattern not only causes overweight and obesity, but also is the cornerstone of other chronic diseases such as cardiovascular discuses.

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The family's preferences for food items are unacceptable if poor nutritional meals are consumed instead of rich ones (Alkerwi *et al.*, 2015). Nowadays, educational sciences derived from educational theories have important roles in changing the knowledge, behavior, and habits of people. Nutrition education content and process of behavioral change should be provided based on the principles of education for achieving behavioral goals (Miller and Cassady, 2015).

The analysis of food patterns is a guideline in providing practically nutritional recommendations because presenting these recommendations for people in the form of food patterns is more comprehensible rather than presenting the role of nutritional materials (Djazayery *et al.*, 2008). These patterns include a wide range of consumer's behaviors related to food materials such as their current intake amount and type, cooking method, serving, and wastes. A food basket is a pattern consisting of sufficient amount of energy and essential minerals and other ingredients, so that its combination would be balanced to provide the necessary energy for doing daily activities and increase body resistance against diseases (Asghari *et al.*, 2012). Besides, sufficient food pattern is based on the principles including balance, nutritional needs, protection of peoples' health, individual differences, habits, food preferences, nutritional literacy, knowledge, distribution of facilities, and enough economic and physical access at the national level (Pelletier, 2015).

The aims of providing suitable basket include:

- Designing nutritional programs, training people in order to select more qualified meals for protecting their health, preventing from chronic diseases, and promoting nutritional literacy.

- Comprehensive policy-making of food and nutrition

- Implementing interventions and providing essential supports for achieving rich nutritional food materials adapted by people's habits and preferences (Gibson, 2016).

Nutrition education can be very effective in modifying inappropriate nutritional behaviors and enhancing peoples' knowledge. Different investigations confirmed the impact of nutrition training over nutritional performance of families (Friel *et al.*, 1999, Pei-Lin, 2004, Shariff *et al.*, 2008). Moreover, the value of educational programs depends on their effectiveness, which is, subsequently, associated with using theories and models efficiently.

Regarding the role of healthy nutrition in preventing and controlling contagious diseases, this study was conducted to investigate the effectiveness of interventions, the range of nutrition patterns change in the studied populations after intervention, find the best theories, reasons, and ways of implementing the interventions.

Materials and Methods

The PubMed, Science Direct, Scopus, and Cochrane databases were searched using the keywords “nutrition behavior” or “food behavior” or “dietary behavior” and “model” or “theory” and “intervention” or “predict” without any time limitation in February 2018. The articles published from 2013 to 2017 were studied. Retrospective cohort, prospective, case-control, cross-sectional, qualitative studies, protocols, as well as investigations using electronic tools for performing the intervention were removed from the present study. Theory-based interventions conducted in a specific duration of time were selected for this investigation. Relevance of the studies' subject to the main aim was confirmed in three stages including reviewing the title, the abstract, and the main text of the articles. As a result, 3090 articles were primarily monitored. Followed by removing the 558 repeated papers, a total of 153 articles were studied, among which 182 of them were review articles and 1969 papers were not related to the main subject of the present study. Consequently, 219 articles remained, of 78, 28, and 14 articles were cross-sectional, qualitative, and protocol, respectively. Of the investigated studies, 71 papers were not theoretically oriented, which resulted in the final number of 28 articles. Followed by investigating the main texts of the studies, we found that one paper was a review study, one paper was a part of

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another study, and the last one was a cross-sectional investigation, which were omitted. The other 25 articles were included in the study. The screening process, exclusion, and final selection of articles are shown in **figure 1**.

Results

Regarding the included studies, eight models or theories were used in the interventions. Respectively, 4, 1, 1, 1, 1, 2, 5, and 9 studies were conducted based on Social Cognitive Theory, Empowerment model, Social-Ecological Theoretical Framework, BASINEF model, PENDER Health Promotion, Self-determination theory, Theory of Planned Behavior, and Health Belief Model. The details and results of these studies are presented in **Table 1** to find the most qualified studies.

Social cognitive theory: Four studies conducted their nutritional interventions based on the social cognitive theory (Healthy Hidayanty *et al.*, 2016, Ko *et al.*, 2016, Mead *et al.*, 2013, Najimi and Ghaffari, 2013). Two studies were carried out among adults, of which one article studied obese individuals (Ko *et al.*, 2016, Mead *et al.*, 2013). The other two studies were on students and adolescents (Healthy Hidayanty *et al.*, 2016, Najimi and Ghaffari, 2013). In one of the mentioned interventions, parents and teachers of the students were also involved (Najimi and Ghaffari, 2013). In another intervention, students' parents received a weekly nutrition education booklet (Healthy Hidayanty *et al.*, 2016). One of the four studies combined social cognitive theory with the social ecological model (Mead *et al.*, 2013).

In designing interventions, self-efficacy was considered in all studies (Healthy Hidayanty *et al.*, 2016, Ko *et al.*, 2016, Mead *et al.*, 2013, Najimi and Ghaffari, 2013). Three studies considered observational learning and outcome expectation as effective constructs in interventions to improve the participants' nutrition (Healthy Hidayanty *et al.*, 2016, Ko *et al.*, 2016, Najimi and Ghaffari, 2013). Furthermore, the ability to behave was another component considered in three of the four included studies (Ko *et al.*, 2016, Mead *et al.*, 2013, Najimi and Ghaffari, 2013). Environmental factors in two studies (Healthy Hidayanty *et al.*, 2016, Ko *et al.*, 2016), stress control in one study (Najimi and Ghaffari, 2013) and self-regulation in one study (Healthy Hidayanty *et al.*, 2016) were considered as effective constructs.

Mead *et al.* conducted a study based on the ecological social model, used mass media such as television, radio, and extensive social activities in health centers, schools, and so on (Mead *et al.*, 2013). The other three studies used training sessions in various forms such as lectures, group discussions, goal setting with the help of participants for training. They also used booklets and training booklets as educational assistance (Healthy Hidayanty *et al.*, 2016, Ko *et al.*, 2016, Najimi and Ghaffari, 2013).

Empowerment model: The aim of this study was to determine the effect of education on obese or overweight women's abilities to modify their eating behaviors. The study was conducted in four continuous phases that included threat perception, problem solving, participatory education and evaluation. To remind all the topics discussed in the training sessions, participants were provided with a booklet. The constructs used in the study were knowledge, attitude, self-esteem, and self-efficacy (Mataji Amirrood *et al.*, 2013).

Social ecological theoretical frame work: This study was conducted among females in 11 different communities, based on Social Ecological Theoretical Framework. The aim was investigated the effect of intention on nutritional diet program. The program focused on knowledge, attitudes, self-efficacy constructs as well as problem-solving skills. Training sessions were devoted to lectures and practices to develop skills related to food planning, food shopping, reading food labels, and ways to buy nuts (Summers and Klassen, 2013).

BASNEF model: The study was conducted on female students in which the parents of the participants were also present to further influence

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the intervention in the study. In order to empower healthy eating behaviors, 2 sessions were held for students by lecture method and one session was held for the students' parents by instructional method. A textbook was also administered as a teaching aid for students. The constructs of interest included belief, attitude, abstract norm, empowerment factors, dietary intention, and behavior (Pirzadeh *et al.*, 2014).

Pender's health promotion model: One study used this model to improve people's nutritional behavior. The constructs considered in the study were perceived benefits, perceived barriers, perceived self-efficacy, commitment to action, interpersonal and situational effects, as well as nutritional behavior. The training was conducted through lectures, questions - answers, and group discussions. Training guide for healthy eating behaviors was also used as an educational assistance (Khodaveisi *et al.*, 2017).

Self-determination theory: Two studies were conducted using self-determination theory with the aim of improving nutritional status (Girelli and Luccidi, 2016, Leblanc *et al.*, 2015). One study was conducted on students with the help of local teachers and volunteers (Girelli and Luccidi, 2016). Another study was also conducted over women and men aged 25 to 50 years to improve their knowledge about a Mediterranean diet (Leblanc *et al.*, 2015). Motivation and attitude constructs were considered as effective constructs in both studies (Girelli and Luccidi, 2016, Leblanc *et al.*, 2015). In one study, the intervention consisted of three group sessions with four telephone calls and a recorded diet (Leblanc *et al.*, 2015). The other study consisted of at least two hours of training per week by local teachers and volunteers during the school period (Girelli and Luccidi, 2016).

Theory of planned behavior: Five studies used the theory of planned behavior; two were conducted on students (Maleki *et al.*, 2016, Taghdis *et al.*, 2016), one of which was on female students with type 2 diabetes (Maleki *et al.*, 2016). One study among adults aimed at reducing the consumption of sugary drinks and the other intervention was aimed to change the amount of physical activity (MoveMore) (Zoellner *et al.*, 2016). There was also a study on athletes' coaches to improve the accuracy of their nutritional recommendations (Jacob *et al.*, 2016), and finally a study was conducted on the chefs of child care centers (Yoong *et al.*, 2015).

All five studies used all constructs of the theory of planned behavior (behavior, intention, subjective norms, and perceived behavioral control) (Jacob *et al.*, 2016, Maleki *et al.*, 2016, Taghdis *et al.*, 2016, Yoong *et al.*, 2015, Zoellner *et al.*, 2016).

In three studies, lecture sessions with discussion were used for teaching, while in one study, educators and parents were trained to improve abstract norms in students (Jacob *et al.*, 2016, Maleki *et al.*, 2016, Taghdis *et al.*, 2016). One of the studies, in addition to teaching through lectures, expressed the scenario based on the problem-solving plan (Maleki *et al.*, 2016). One study emailed food menu instructions to the child care centers, along with a training booklet including specific behaviors to chefs based on the theory of programmed behavior (Yoong *et al.*, 2015). Finally, a study taught nutrition to students through phone calls and voice messages (Zoellner *et al.*, 2016).

Health belief model: The results showed that nine studies had performed their nutritional interventions based on the health belief model. Among these, two studies were conducted on students (Ghaderi *et al.*, 2017, Shafiei *et al.*, 2017) and two were performed over older women (Iranagh *et al.*, 2018, Iranagh *et al.*, 2016). Two studies were carried out on young people (Evenson and Sanders, 2016, Tavakoli *et al.*, 2016), one of whom was among medical students (Tavakoli *et al.*, 2016). One study investigated pregnant women (Khoramabadi *et al.*, 2016), one study was conducted on adult women (Shobeiri *et al.*, 2016), and finally a nutritional study was carried out on hospitalized cardiovascular patients (Shojaei *et al.*, 2016).

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All nine studies considered knowledge constructs, perceived sensitivity, perceived intensity, perceived benefits, and perceived barriers (Evenson and Sanders, 2016, Ghaderi *et al.*, 2017, Iranagh *et al.*, 2018, Iranagh *et al.*, 2016, Khoramabadi *et al.*, 2016, Shafiei *et al.*, 2017, Shobeiri *et al.*, 2016, Shojaei *et al.*, 2016, Tavakoli *et al.*, 2016). In addition to the mentioned constructs, six studies used the self-efficacy construct (Evenson and Sanders, 2016, Ghaderi *et al.*, 2017, Iranagh *et al.*, 2018, Iranagh *et al.*, 2016, Shafiei *et al.*, 2017, Tavakoli *et al.*, 2016) and one of the studies used the cues to action construct (Ghaderi *et al.*, 2017).

Eight studies used the lecture method (Evenson and Sanders, 2016, Ghaderi *et al.*, 2017, Iranagh *et al.*, 2018, Iranagh *et al.*, 2016, Khoramabadi *et al.*, 2016, Shafiei *et al.*, 2017, Shobeiri *et al.*, 2016, Tavakoli *et al.*, 2016). Six studies used asking and answering method sessions to increase awareness and motivation (Ghaderi *et al.*, 2017, Iranagh *et al.*, 2018, Khoramabadi *et al.*, 2016, Shafiei *et al.*, 2017, Shobeiri *et al.*, 2016, Tavakoli *et al.*, 2016). In four studies, group discussion was one of the teaching methods (Ghaderi *et al.*, 2017, Iranagh *et al.*, 2018, Khoramabadi *et al.*, 2016, Shobeiri *et al.*, 2016). The method of brainstorming was also seen as an educational method in two studies (Ghaderi *et al.*, 2017, Tavakoli *et al.*, 2016). Dr. Shojaei *et al.* considered face-to-face training to increase patients' knowledge (Shojaei *et al.*, 2016). In addition to lecturing, Evenson *et al.* also used practical demonstrations to improve the inhibitory behaviors of osteoporosis, which included adequate calcium intake, vitamin D, and exercise (Evenson and Sanders, 2016). Finally, five studies used educational assistance such as booklets, pamphlets, photos, and posters (Iranagh *et al.*, 2018, Iranagh *et al.*, 2016, Khoramabadi *et al.*, 2016, Shafiei *et al.*, 2017, Shojaei *et al.*, 2016).

Protection – motivation theory (PTM): One study used protective-motivational theory on individuals over 60 years of age. In this study, the constructs of knowledge, attitude, protective-motivational behaviors, perceived fear, and perceived intensity were evaluated and intervened. In this study, lecturing, brainstorming, and discussion methods were also used to educate the elderly (Rouhi Afkari 2016).

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Table 1. the list of the characters of obtained articles

No	Reference	Theory	Study duration	Aim of study	Findings	Population	Type of study	Year
1	(Healthy Hidayanty et al., 2016)	Social cognitive theory	12 weekly 75-min nutrition education group sessions	Employ social cognitive theory to reduce snacking habits and sedentary activity among overweight adolescents	the intervention group showed a higher reduction in BMI z-scores (−0.08; p<0.05) and waist circumference (−1.5; p<0.05) at 3 months. Significant between-group differences were also observed for decreased snacking habits. the programme improved self-efficacy for reducing these behaviors	238 overweight students aged 11-15 years	Cluster randomized controlled trial	2016
2	(Ko et al., 2016)	Social cognitive theory	8-weeks	To evaluate the impact of an 8-week community-based nutrition education program combined with food baskets on fruit and vegetable consumption	A brief nutrition education intervention combined with food baskets can improve healthy eating among Latinos.	40 Participants were mostly women, from Mexico, uninsured, low income, and overweight or obese.	This mixed methods (pre-post intervention study)	2016
3	(Mead *et al.*, 2013)	Social cognitive theory	12-month program	Improve dietary adequacy, increase physical activity, and reduce risk of chronic disease among Inuit in Nunavut and Inuvialuit in the NWT	A community-based, multilevel intervention is an effective strategy to improve psychosocial factors for healthy nutritional behavior change to reduce chronic disease in indigenous Arctic populations.	246 adults from intervention and 133 from comparison communities	Quasi-experimental pre-/post evaluation study	2013
4	(Najimi and Ghaffari, 2013)	Social cognitive theory	12 months	To assess the effectiveness of an educational intervention based on social cognitive theory on increasing consumption of fruit and vegetable	Intervention based on social cognitive theory led to increase in the consumption of fruits and vegetables among students	138 students	The randomised study	2013
5	(Mataji Amirrood *et al.*, 2013)	Empowerment Model	two months	determine the impact of training on women's capabilities in modifying their obesity-related dietarybehaviors	The educational intervention performed whit applying family-centeredempowerment model in this study was proven effective in women	90 overweight/obese women	A quasi-experimental study with Pretest-Posttest design	2014

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6	(Summers and Klassen, 2013)	social-ecological theoretical framework	20-week intervention took place from 2001 to 2003	To examine whether expressed intentions modifed program impact on diet	Sustained intentions predicted dietary change	187 African American women	single-arm studys	2013
7	(Pirzadeh *et al.*, 2014)	Belief, Attitude, Subjective Norm, and Enabling Factors (BASNEF) Model		Determine the effectiveness of an educational program based on the Belief, Attitude, Subjective Norm, and Enabling Factors (BASNEF) Model on the nutritional behavior	after educational intervention, 36.1% of the students had unfavorable nutritional behavior and nutrition education intervention based on the BASNEF model could promote the nutritional behavior in girl students	72 second grade, middle school, female students in Isfahan city	quasi-experimental study	2014
8	(Khodaveisi *et al.*, 2017)	Pender's Health Promotion Model	October 2014 to May 2015	Investigate the effect of Pender's Health Promotion Model to improve the nutritional behavior of overweight and obese women	Pender's HPM-based training improved nutritional behavior and some constructs of the model. Therefore, this educative model can be used by healthcare providers to improve the nutritional and other health promoting behaviors.	108 eligible women	quasi-experimental study	2016
9	Vicky Leblanc et al.[21]	self-determination theory	12-week nutritional program	Determine gender differences in the impact of a nutritional intervention based on the self-determination theory and promoting the Mediterranean diet	Changes in eating-related self-determined motivation were positively associated with changes in the Mediterranean diet adherence in response to the intervention and at follow-up in men only, suggesting that the nutritional program seems to fit better men than women.	64 men and 59 premenopausal women aged between 25 and 50 years	self-determined motivation forms	2016
10	(Girelli and Luccidi, 2016)	self-determination theory	9 months	Enhance active lifestyles and energy-balance nutritional behavior in underserved school-aged children.	results showed the intervention to be successful in improving healthy lifestyles in physical activity and healthy eating behaviors in school-aged children	In total, 477 participants for the intervention group, and 389 participants for the control group	a quasi-experimental design	2016

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11	(Zoellner *et al.*, 2016)	Theory of Planned Behavior	6 month	Assess the effectiveness of a behavioral intervention targeting sugar-sweetened beverages consumption	SIP smarter is an effective intervention to decrease SSB consumption among adults and is promising for translation into practice settings. By using health literacy-focused strategies, the intervention was robust in achieving reductions for participants of varying health literacy status.	296 participants	Randomized-controlled trial	2016
12	(Maleki *et al.*, 2016)	Self-determination theory	December 2010 and finished in January 2012.	Examine the effect of training to intention to preventative nutritional behaviors for type-2 diabetes	The mean score of the theory components (attitudes, subjective norms, perceived behavioral control, and intention) was higher in the control group. Also, results showed all of the theory components significantly increased after the education in the intervention group.	200 (11-14 year old) girls	Experimental study	2016
13	(Jacob *et al.*, 2016)	Self-determination theory	Two 90-minute meetings delivered during a 2-week period	Evaluate the effectiveness of an intervention aimed at improving the accuracy of coaches' recommendations on sports nutrition	A theory-based intervention combined with a decision-making algorithm maintained coaches' sports nutrition knowledge level over time and helped them to provide more accurate recommendations on sports nutrition	41 coaches	Quasi-experimental study	2016
14	(Taghdis *et al.*, 2016)	Self-determination theory	from Jan 2013 to Jun 2014	Examine the effect of education, with application of the theory of planned behavior, on improvement of fruits and vegetables consumption	Increased behavioral intention, attitude, subjective norms and perceived behavioral control can promote fruit and vegetable consumption among the students	184 fourth, fifth and sixth grade students	Quasi-experimental study	2016
15	(Yoong *et al.*, 2015)	Self-determination theory		Examine the impact of providing printed educational materials on childcare service cooks' intentions to use nutritional guidelines and provide fruit and vegetables on their menu.	The use of educational materials can improve childcare service cooks' intentions to use nutritional guidelines; however, as a standalone strategy, it may not improve provision of food on menus	77 childcare services	Randomized controlled trial	2016

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No	Reference	Theory	Study duration	Aim of study	Findings	Population	Type of study	Year
16	(Evenson and Sanders, 2016)	Health believe model	8-week period	Examine young adults' knowledge of osteoporosis, health beliefs, self-efficacy, dietary calcium, and vitamin D intakes as measures of preventive behaviors.	Either educational method could be implemented in courses or community education to increase knowledge and health beliefs.	153 young adults	Pre-post test	2016
17	(Shobeiri *et al.*, 2016)	Health believe model	Between October 2014 and March 2015	the influence of intervention of nutritional counseling (based on HBM) on the information, attitude and performance of females	Mean scores of the awareness and various constructs of the model (perceived vulnerability, perceived severity, perceived benefits, perceived barriers and performance) were enhanced considerably in the case group over time (immediately after and two month) after interposition	80 women	Quasi experimental research	2016
18	(Khoramabadi *et al.*, 2016)	Health believe model	One month	Assess the effects of training on the Health Belief Model on dietary behaviors of a sample of pregnant Iranian women.	Educational interventions based on health promotion patterns can be effective in enhancing awareness, better understanding of risks, reducing barriers to healthy behavior and ultimately, improving women's health and nutritional performance during pregnancy.	130 pregnant women	Randomized controlled clinical trial	2016
19	(Shojaei *et al.*, 2016)	Health believe model		creating perceived susceptibility and perceived severity in the intervention group	educational intervention caused a signifcant increase in the mean scores of knowledge, perceived severity and perceived benefts and barriers in the intervention group but did not cause a signifcant increase in the mean score of nutritional behavior	64 patients	Semi-experimental clinical trial	2016
20	(Tavakoli *et al.*, 2016)	Health believe model	During the period 2011 - 2012	Determine the effects of education on patterns of dietary consumption	The significant improvement in the experimental group's mean knowledge, HBM constructs , and behavior scoresindicates the positive effect of the intervention.	242 medical students	Quasi-experimental study	2016

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No	Reference	Theory	Study duration	Aim of study	Findings	Population	Type of study	Year
21	(Iranagh *et al.*, 2018)	Health believe model	2-week nutrition education program	Determine the impact of Health Belief Model (HBM)-based intervention on the nutritional behavior	nutritional behavior was positively affected by the HBM constructs comprised of perceived susceptibility, self-efficacy, perceived benefits, and barriers after the intervention program	200 elderly women	Clinical trial study	2016
22	(Iranagh *et al.*, 2016)	Health believe model	Six months' study program	Determine efficacy of HBM-based nutritional educational intervention on knowledge, belief and behavior	This study confirms the effectiveness of HBM-based nutritional education on healthy nutritional perception, belief and behavior among elderly women	100 elderly women	Cluster randomized controlled trial	2017
23	(Ghaderi *et al.*, 2017)	Health believe model		Determine the effect of combined educational inference based on HBM model about preventing iron deficiency anemia on the enhancement of knowledge, attitude and behavior	Results of this research indicated that the education based on HBM model is effective on the enhancement of knowledge, attitude and behavior of students in the field of preventing iron deficiency anemia.	128 high school girls	Quasi experiential study	2017
24	(Fathi *et al.*, 2017)	Health believe model	Four weeks. four 45-minute sessions	Determine the effect of nutrition education on reducing the consumption of unhealthy snacks in female primary school student	The nutrition education program (designed based on the HBM) was effective in reducing the consumption of unhealthy snacks as it increased the scores of the Health Belief Model constructs and decreased the score of perceived barriers	88 students	Experimental interventional study	2017
25	(Rouhi Afkari 2016)	Protection motivation theory	2 months	Assessing the effect of an education program based on protection motivation theory (PTM) on imroving nutritional perfomance	The mean score of knowledge, behavior, protection-motivation, fear, perceived severity and items of food frequency questionnaire had increased significantly in experimental group	200 elderly people over 60 years old	Quasi-experimental study	2016

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Discussion

According to the findings of this review over 25 articles (**Table 1**), the most target group in these studies were school students, which is mainly due to their availability and their easier educability (Ivanovic and Marambio, 1989). Followed by the students, women were in the next category as the most important target group, which can also be due to their responsibility and sense of responsibility (Roy, 2008).

In the field of constructs, self-efficacy construct seemed to be the most important for researchers that was followed by the attitude construct. These three constructs were common in many models and theories of health education and health promotion, which can be considered as the most basic factors of behavior change (Sheeran *et al.*, 2016). Perceived sensitivity and perceived severity constructs, as common constructs of health belief models, protection-motivational theory, as well as perceived barrier and benefits constructs were also common in the two mentioned models except in protection-motivation theory. Constructs of intention, subjective norms, perceived behavioral control, etc. were used less frequently in studies.

In the field of educational methods, lectures, group discussions, and brainstorming were considered mainly by researchers. This can be justified by their ease of application. On the other hand, booklet teaching materials and pamphlets were mostly used in studies.

According to the findings, the best results were achieved through the empowerment model. The study conducted based on this model was systematic with evident goals. Its duration was two months that was a suitable time; it was not so short that considerable changes would not happen and not so long that lead to tiredness and confusion of participants. Some studies with one-year duration reported contradictory findings in the follow-ups intervention. On the other hand, a number of these investigations used too much constructs and that lead to confusing results. This study also targeted at women, as the focal members of family in every society, modifying their nutritional behaviors that can lead to behavior change in other family members based on their maternal roles. Consequently, the society will change. The main goal of empowerment model is to modify the health of family system. The focus of this model is to increase the efficacy of people and families in three motivational, cognitive (self-esteem, self-controlling, self- controlling), and individual characteristics (knowledge, attitude, and perceived threats). Four phases were designed to implement this model in a continuous continuum; threat perception, problem solving, participation in education, and goals assessment awareness development, knowledge, self-efficacy, and participation. The content of all sessions was included in booklets to encourage the families to participate in the food behavior modification process. The mean scores of knowledge, attitude, self-esteem, and self-efficacy increased after the intervention. An increase was also observed in the control group, but it was not significant (Mataji Amirrood *et al.*, 2013).

Conclusion

To change the individuals' eating behaviors, the study framework should be selected based on an appropriate theory and model according to the target group characteristics as well as the duration of training. According to individual characteristics, special attention should be paid to the living environment of the individuals in behavioral changes. To this end, they should be involved in educational planning.

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Authors' contributions

Ostovarfar J & Kaveh MH, principal investigor, conceptualized and designed the study, prepared the draft of the manuscript and reviewed the manuscript; Kaveh MH & Ostovarfar M, led the data collection in the Northern region, adviced on the data analysis and interpretation and reviewed the manuscript; Eftekharian F & Ostovarfar M , led the data collection in the Southern region and reviewed the manuscript; Somayeh Z and Mouhebat V, led the data collection in the central region and

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reviewed the manuscript; Ostovarfar J led the reviewed the manuscript; Ostovarfar J, Kaveh MH, and Mouhebat V, conducted the study, data analysis, and interpretation, assisted in drafting of the manuscript, and reviewed the manuscript.

Availability of data and materials

The dataset used and analyzed during the current study is available from the corresponding author on reasonable request.

Consent for publication and ethical approval

The ideas expressed are related to the authors and do not need ethical approval from ethics committee Shiraz University of Medical Sciences

Declaration of conflicting interests

The author(s) declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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