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REVIEW

The role of nutritional interventions in increasing fruit and vegetable intake in the elderlies: a systematic review

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Abstract
Background The consumption of fruit and vegetables in old ages is particularly important, so that the appropriate consumption amount leads to reduction in the risk of chronic diseases. To increase consumption of fruit and vegetables and modify consumption pattern in the elderlies, training programs and appropriate intervention can be designed and implemented.
Aims The study was done to assess and compare nutritional intervention-based training methods and education using theories and health education models for the consumption of fruits and vegetables in the elderlies.
Methods Electronic search using keywords of Country Review Information Bank (Magiran), Scientific Information Database, Pub Med, Science direct, Science, Biomed central from the beginning of March 2014 to end of April 2015 was performed.
Results Ten interventional studies were assessed in this systematic study. The interventions were divided into two groups of studies, a total of five studies, theories and health education models were the basis of training intervention and the other five studies that include their interventions without the use of theories and health education models was carried out. Of ten interventional studies, three studies as before and after and seven studies as the intervention and control was performed.
Discussion The results showed that education-based theory and health education models have a greater impact on the consumption of fruit and vegetables in the elderlies.
Conclusions The duration and interventions performing method, environmental factors and educational programs using appropriate models and theories are important on the effectiveness of interventions to increase consumption of fruit and vegetables in the elderliness.

Keywords Elder · Older · Fruits and vegetables · Intervention · Education · Health education theories and models

Introduction

The elderly phenomenon is accompanied by biological changes, metabolism, mental and emotional changes, which is a progressive and irreversible natural phenomenon [1]. As well as increase in age leads to nutritional risks associated to the elderliness [2]. Chronic diseases related to food pattern such as obesity, lipid disorders pattern, impaired glucose tolerance, mellitus diabetes and hypertension are the main issues related to the elderlies nutrition which affect their health and longevity [3].

But the nutritional status of the elderlies' consumption of fruits and vegetables is of great importance, so that appropriate use reduces the risk of chronic diseases [4–6]. Increasing fruit and vegetable consumption decreases the risk of chronic diseases to 20 % [7]. Several studies have shown link between adequate consumption of fruits and vegetables and the reduction of cancer risk [8, 9], obesity [10], diabetes [11] and a significant reduction in blood pressure [12]. Increased consumption of fruit and

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vegetables also reduces the risk of heart attacks and cardiovascular disease [13].

Food guidelines of World Health Organization for enjoyment of the eating fruits and vegetables' benefits recommend at least five times daily intake [14]. According to benefits of fruits and vegetables consumption in reducing disease, studies suggest inappropriate consumption by the elderlies. A study to assess fruit and vegetable intake among Canadian elderlies was conducted which showed that 53 % of older people do not eat enough fruits and vegetables [15]. A study in Iran showed that 53 % of Iranian elderly people do not eat in against the recommended amounts of fruits and vegetables [16].

Several factors such as nutritional knowledge and awareness of the effects of fruit and vegetable consumption on health, belief in the beneficial effects of the consumption of fruits and vegetables, skills and confidence in purchasing, preparation, consumption and income in interaction with each other influence the pattern of adult daily consumption [17]. To increase nutritional knowledge and consumption of fruits and vegetables in the elderlies and improving the consumption pattern of this community people we can design and implement training programs and appropriate interventions [18]. Effectiveness of educational and interventional programs depends on appropriate use of behavioral science methods and theories [19]. How much aged a good scientific support with basic needs exist, the effectiveness of training programs and nutritional interventions in nutrition behavior change will be more particularly fruits and vegetables [20]. But the problems of this age group for the correct use of fruits and vegetables lead to that their practice do not promote healthy living and perhaps endanger their lives. Studies have shown that the elderly's population is in increasing trend, it is necessary to emphasize the importance of consuming fruits and vegetables during this period and its means of enhancing identified and considered. Therefore, this study was done in purpose to determine the nutritional interventions based on the methods of teaching and training theories and health education models for the consumption of fruit and vegetables in the elderlies.

Materials and methods

In this systematic review, to identify interventional studies in which education is the key intervention to improve and promote the consumption of fruit and vegetables in older adults, electronic search of databases in Persian and English at the beginning of March 2014 to the end of March 2015 was performed.

These articles from Persian base include Country Review Information Bank (Magiran), and Scientific Information Database (SID). In addition, English articles in databases of Biomedcentral, PubMed, Sciencedirect, Web of Science using keywords such as older or elder, nutrition, consumption, fruits vegetables, fruit and vegetable, intake, life style, theory and model, intervention, education were searched.

Inclusion criteria Intervention studies that are just only for consumption of fruit and vegetables in the elderlies, the target group is the elderlies (above 60 years or average age of 60), and the studies Inclusion criteriaare published in the January 2005 to March 2015. The reason for selecting this period of time is the increase in the elderly population in developed countries and the developing world, particularly in developing countries in recent years and caution to the health of this age group.

Exclusion criteria Descriptive, qualitative, reviewing structured review, meta-analysis studies have been done in them; studies about consuming fruits and vegetables, along with other interventions for performing health behaviors in the elderlies. To determine the quality of the articles, the researchers according to inclusion and exclusion criteria review the articles and articles that were not of good quality were excluded according to the study.

A summary of assessed study features that the researchers had studied were recorded in the table. Details of these tables include: name of authors/year, time and place of study, purpose of this study, target group, sample size, duration of study, theory/model, the studied variables, how to do the intervention and the results of the intervention.

Results

Of the 12,738 articles in English and Farsi, after excluding large number of articles based on the titles and abstracts, 77 articles were selected in line with goals of the study. Among remaining articles, 51 articles were excluded due to inappropriate target group. 26 articles were assessed more accurately and 16 articles due to the consumption of fruit and vegetables in elderly people was accompanied by other eating behaviors and physical activity and the assessed age of older and the average age of less than 60 years were excluded from the study and 10 articles (2 Farsi and 8 English article) were included in this excluded from the study (see Fig. 1).

In this study, the examined articles were divided into two major categories. (1) The studies the intervention of which was on the basis of the theories and health education models [20–24]. (2) Studies the educational interventions of which were carried out without the use of theories and health education models [25–29]. All three studies as before and after [24, 28, 29] and 7 intervention and control

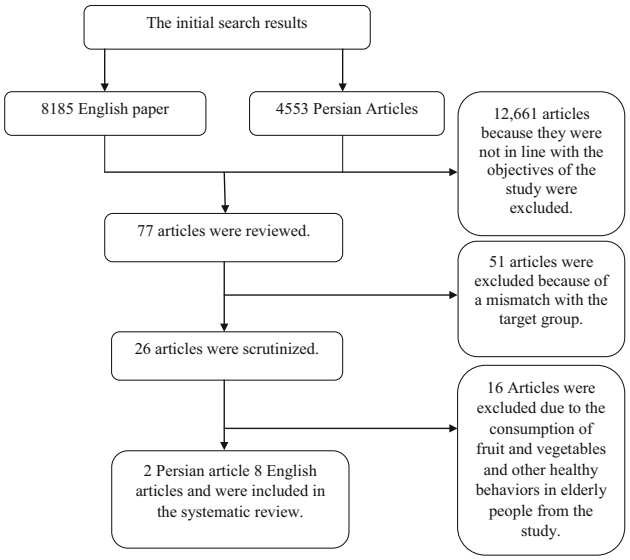

Fig. 1 Articles assessed about consumption of fruit and vegetables in elderly people

were carried out [20–23, 25–27]. Table 1 shows studies in which health education theories and models were the basis of intervention. Table 2 shows studies in which the educational interventions were carried out without the use of theories and models of health education.

A. Interventional studies using theories and models of health education (Table 1)

Five articles examine the effects of interventions through health education theories and models.

A study by Khezeli Mehdi et al. in Gilangharb (town in the West of Iran) as intervention and control was carried out in over 150 elderly people covered by the urban and rural health centers. The study examined the effect of education on nutritional awareness and stages of change of TTM theory to increase consumption of fruit and vegetables in the elderliness. 75 patients in the control group and 75 patients in the intervention group were randomly selected. In this intervention, a two-stage intervention for elderlies participated took place. In the first case of intervention, those who were in the pre-contemplation, contemplation and preparation were divided into five groups and then two training sessions were held for each group. Training was performed as brainstorming and group discussion, a poster was delivered for installation in their home's kitchen and educational pamphlet to the elderlies. In the second stage of intervention, involving all persons of intervention group, people were enrolled in action and maintenance. Providing the experience of interventional group has been done by diet practices, providing training with instilling self-management skills and education was done during the two sessions to the elderliness. Knowledge measurement about food groups with emphasis on fruits and vegetables using S-CVI tool, and measurement of the stages' pattern changes includes pre-contemplation stage, contemplation stage, preparation stage, action stage, maintenance stage before and 3 months after intervention study which were examined and compared. The results of intervention showed statistically significant differences in the awareness mean scores, elderlies advancing among changing process from pre-contemplation stage and contemplation toward preparation stage (motivation) (and more active) on the consumption of fruit and vegetables in the intervention and control groups after intervention. As well as there is a statistically significant difference between the structures of perceived benefits, self-efficacy and perceived barriers of consumption of fruits and vegetables in the intervention and control groups after the intervention was found [20].

A study by Lilly Salehi et al. in Tehran (capital of Iran) was done as intervention and controls over 400 elderlies in elderly's centers. A study was done to examine the impact of training program-based TTM or Trans-theoretical model to increase consumption of fruit and vegetables for 5 times daily in the elderlies. 200 in the control group and 200 in the intervention group were randomly selected. The intervention consisted of four sessions per week, each week a meeting was held and the time of each session was 90 min. First session: overview of fruit and vegetable consumption; second session: using the process of raising awareness about changing unhealthy dietary behavior and changing process; third session: focus on the content of the second, fourth session: help people to deal with obstacles and skill for supply and consumption of fruit and vegetables. As well as a manual and a CD about the benefits of fruits and vegetables and their values was delivered to the elderlies. Anthropometric measurements and people's preparation stage measurement in terms of behavior changing, self-efficacy, balancing decisions of daily consumption of fruits and vegetable in the elderlies before and 4 weeks after the intervention were examined and compared. The results of intervention showed a statistically significant difference in mean daily intervention score of fruit and vegetables, structures perceived benefits, self-efficacy and perceived barriers between the intervention and control groups after intervention as well as a statistically significant difference in elderlies advancement in the changing stages from pre-contemplation to contemplation stage and from preparation and contemplation stages toward operation and maintenance stages among intervention and control groups, respectively [21].

A study by was done by Kramish Campbell Marci and colleagues at Central North Carolina (one of the states of America) as intervention and control over 735 elderly

Table 1 Summary of interventions to increase consumption of fruit and vegetables in the elderly using theories and models of health education

First author name/Study publishing year	Time and place of study	Purpose of the study	Target group	Sample size	Duration of intervention
Khezeli Mehdi/ 2012	2011 Iran (Gilan gharb)	The impact of education on nutrition knowledge and consumption of fruit and vegetables in the elderly: based on stages of change model (intervention and control)	Elderly of 60 years and above in urban and rural health centers	75 elderlies in the intervention group and 75 elderlies in the control group	3 months
Salehi Lily/ 2013	During the years 2008 to 2009 Iran (Tehran)	The effect of educational program based on the Trans-theoretical model of fruit and vegetable consumption by as much as five times a day in the elderly (intervention and control)	Elderly 60 years and above and in the elderly center of Tehran	200 persons in the intervention group and 200 persons in the control group	4 months
Kramish Campbell Marci/ 2009	Over the years 2001 to 2004/America (33 county area of central and eastern North Carolina)	A randomized trial of tailoring and motivational interviewing to promote fruit and vegetable consumption for cancer prevention and control in a sample of older adults (average age of 66 years) (intervention and control)	Older adults average age (of 66 years) People were invited through a register in the study From 33 provinces of central and eastern North Carolina, respectively	181 cases in group alone tailored print communication (TPC), 185 brief telephone based motivational interviewing (TMI) and 181 TPC/ TMI188 cases in control group	Unknown
Bradbury J/2006	February, 2000, to July 2001/dental-student Clinics at Newcastle Dental Hospital	Evaluate the effectiveness of a tailored nutrition intervention that aimed to increase the fruit and vegetable intake of edentulous patients receiving replacement Conventional dentures (Intervention and control)	Toothless elderly with an average age of 65.5 in the intervention group and 66.6 in the control group referred to dental student clinics to receive dental care	30 elderly toothless elderly people in the intervention group and 28 toothless elderly in the control group	6 weeks
Hendrix J Sara/2008	During the years 2004 to 2006/senior centers in all 12 Area Agencies on Aging (AAA) of Georgia	Evaluate a community-based intervention designed to increase knowledge and intakes of fruits and vegetables in older adults (before and after the intervention)	Study on elderly with an average age of 75.83 years in senior centers was performed	558 elderly people were studied before and after the intervention	4 months

First author name/Study publishing year	Theory/model	Studied variables	How to do intervention	The results of intervention
Khezeli Mehdi/2012	The pattern of changing process	Knowledge measurement about food groups, with emphasis on fruits and vegetables using S-CVI Assessment of process changes include: pre-contemplation, contemplation stage, the stage of preparation, action, maintenance phase	The first stage of intervention: People who were in the pre-contemplation, contemplation and preparation stages were divided into five groups and then held two sessions for each group Training performed as brainstorming and group discussion, a poster was delivered for installation in their home's kitchen and educational pamphlet to the elderlies	Existing significant differences in the mean knowledge score about fruit and vegetable consumption in the intervention and control groups A significant difference between elderly's advance process between changing process of pre-contemplation and contemplation (incentive) preparation and (more active) for fruit and

Table 1 continued

First author name/Study publishing year	Theory/model	Studied variables	How to do intervention	The results of intervention
			The second phase of intervention: With the participation of all in intervention group, people were enrolled in action and maintenance Providing the experiences of intervention group of their healthy dietary Then providing training with instills skills and self-management skill in two sessions After completion of the study training were given to the control group	vegetable intake in the intervention and control group A significant differences between the perceived benefits structures, self-efficacy and perceived barriers to consume fruits and vegetables in the intervention and control groups
Salehi Lily/ 2013	Trans-theoretical model (TTM)	Anthropometric measurements Assessing the readiness stage of people to change behavior, balancing daily consumption self-decisions of fruit and vegetables	Intervention included: 4 training sessions per week and one session each week and each session was 90 min First session: consumption overview of fruits and vegetables Second session: the process of raising awareness about the unhealthy dietary behavior and processes of change Third session emphasis on the content of second session Fourth session: helping people to deal with obstacles and skills to supply and consume fruit and vegetables Delivering manual and CD about the benefits of fruits and vegetables and their values	Statistically significant increase in mean daily intake of fruit and vegetables in the intervention and control groups Statistically significant differences in the average daily consumption of fruit and vegetables in the intervention and control groups Statistically significant difference in elderly's advancement in the stage of change from pre-contemplation to process of reflection and preparation as well as the process of reflection and preparation for the operation and maintenance of the intervention and control groups Statistically significant difference between the structures perceived benefits, self-efficacy and perceived barriers between the groups

Table 1 continued

First author name/Study publishing year	Theory/model	Studied variables	How to do intervention	The results of intervention
Kramish Campbell Marci/2009	Health behavior change theory communication theory, social marketing principles, and computer-based programs and algorithms to produce personally relevant health messages for each project participant (TPC) and client-centered, collaborative decision-making approach, giving nonjudgmental feedback, allowing for resistance, and encouraging the participant to make the argument for change (TMI)	Consumer review servings per day based on the 35-item, two-item, and averaged F&V FFQs	The first group or TPC Received a series of four individually-tailored, printed newsletters The second group or TMI Received a series of four brief (approximately 20 min) telephone motivational calls The third group or combination of TPC and TMI groups received four individually-tailored, printed newsletters and four motivational calls The fourth group Received two generic health education mailings during the intervention period and four individually-tailored print newsletters after the final survey	Statistically significant increase in mean daily fruit and vegetable intake among the study group 3 or a combination of both TPC and TMI group compared to the intervention group and the control group after intervention Statistically significant differences from effect was concentrated in the N-CRC subset versus CRC survivors The combined intervention was also found to be most cost-effective for the N-CRC group, with TPC more cost-effective than TMI
Bradbury J/2006	Stage of change pattern	Stage of Change was assessed pre- and post-intervention by means of an algorithm that divides precontemplators into those who are and are not aware of their low intake, by taking into account fruit and vegetable intake Perceived chewing ability	Intervention consisted of two sessions of individual counseling with a registered dietitian Providing a nutritional training tailored to each individual (the contents of each package includes an awareness of the relationship between diet and disease, barriers such as lack of time and money, specific issues such as chewing food special guide for the elderly)	Statistically significant differences in perceived chewing ability in the intervention group than the control group after intervention Statistically significant differences in the stage of readiness to move into action in the intervention group than the control group after intervention Statistically significant increase in mean consumption of fruit and vegetables in the intervention group than the control group after intervention

Table 1 continued

First author name/Study publishing year	Theory/model	Studied variables	How to do intervention	The results of intervention
Hendrix J Sara/2008	Belief Model Health	Evaluate the demographic and general health status of Elderly evaluate fruit and vegetable consumption at breakfast, lunch, evening meals and snacks. Knowledge of the recommended servings Knowledge of the obstacles to consumption of fruits and vegetables such as dental problems, topics of cooking, cost, taste, transmission and other problems	The basic intervention framework was based Belief Model Health Perceived sensitivity and severity (with emphasis on health problems which frequently occur in the elderly) Perceived benefits (consumption of fruits and vegetables to enhance health and reduce disease risk) Perceived barriers (emphasis on poor access to information and forget information about the consumption of fruits and vegetables) Help to act (on what people tell you about their consumption of fruits and vegetables) Self-efficacy (showing and reinforce a variety of ways to consume fruits and vegetables) Duration of 8 sessions about 45 to 60 min Use of nutritionists from the University of Georgia The use of curriculum-based educational issues Developed of previous successful programs at the University of Georgia for older people to increase consumption of fruit and vegetable servings	Statistically significant increase in the average daily consumption of fruit and vegetables To at least 7 serving after intervention Statistically significant increase in consumption of 7 to 10 serving recommendations for fruits and vegetables on a daily basis From 7 percent to 57 percent after the intervention Statistically significant increase in the consumption of fruits and vegetables reduce the barriers after intervention

people covered by 33 areas of Central North Carolina. It was a randomized controlled study to increase consumption of fruit and vegetables in the elderlies with the use of appropriate interventions and motivation for cancer prevention. 181 people in a group that received only a series of tailored print materials were named as TPC group, 185 people in a group that was only based on the phone call-received motivational intervention were named as TMI group, 181 people put in a group that combined and received a series of tailored print materials and phone call for the motivational intervention were named TPC/TMI group and ultimately control group consisted of 188 elderlies who were randomly selected. This intervention has been done on the basis of various theories, including theories of behavioral change, communication theory, principles of social marketing and computer-based programs in interventions group. TPC group received series of four-subject newsletter fitted with each person. TMI group received four calls according to motivational intervention each time for 20 min. The group TPC/TMI received total intervention of these two groups and the control group received only public health education. Serving consumption of fruit and vegetable in the elderlies before and a specified time after the intervention was compared. The intervention results showed a statistically significant increase in mean daily intake score of fruits and vegetables in a group which was a mixing of both TPC and TMI group compared to the two another intervention group and the control group after the intervention [22]. The combined intervention was also found to be most cost-effective for the N-CRC group, with TPC more cost-effective than TMI.

A study was done by Bradbury et al. in Newcastle (England) as intervention and control over 58 applicant elderlies to dental clinic for dental care. This was a study for examining the impact of interventions to increase consumption of fruit and vegetables in the toothless elderlies. 28 elderly people without teeth in control group and 30 toothless elderlies in the intervention group were randomly selected. The intervention consisted of two sessions of individual counseling with a registered dietitian, providing nutritional training package tailored to each person, each packet contains knowledge about the relationship between diet and disease, barriers such as lack of time and money, topics such as chewing and special guideline for elderly's diet. In the state intervention, the person's situation and their progress during the process of fruit and vegetable consumption and perceived chewing ability was evaluated. The results of intervention showed statistically significant differences in the chewing perceived ability in the intervention group and the control group, a statistically significant difference to move from readiness stage into action in the intervention group than the control group and statistically significant increase in mean consumption of fruit and vegetables in the intervention group than the control group after their intervention [23].

A study by Hendrix J Sara et al. in Georgia (one of the states of America) before and after intervention in 558 elderlies who were covered by elderliness centers was carried out community-based study to raise awareness and increase the consumption of fruit and vegetables in elderly people. 558 elderly people, for before and after intervention were selected for the study. The main part of the intervention was based on the Health Belief Model which consists of factors such as sensitivity structure and intensity perceived by emphasizing the health problems that frequently occur in the elderlies, perceived benefits, structure by emphasizing that the consumption of fruits and vegetables increase their health and reduce the risk of diseases, barriers perceived structure by emphasizing the poor access to information and forget information about fruit and vegetable consumption, guideline to perform by emphasizing that who gives you information about consumption of fruit and vegetables and self-efficacy by emphasizing on showing and strengthening the ways to consume fruits and vegetables. 8 sessions were held within 45–60 min and nutritionists from the University of Georgia were used for these meetings. Training topics were developed according to curriculum by the previous successful programs of Georgia University for older people in increasing consumption of fruit and vegetables. But this curriculum has been revised due to recommendations of the (USDHHS and USDA) [30]. Evaluation of the demographic characteristics of the elderlies and their general health status, consumption of fruits and vegetables in breakfast, lunch, evening meals and snacks and recommended meals, awareness of the obstacles to consumption of fruits and vegetables such as dental problems, cooking topics, cost, taste, transmission and other problems before and 4 months after the intervention were studied. The results of intervention showed statistically significant increase in the average daily consumption of fruit and vegetable to a minimum seven serving after the intervention, a statistically significant increase in recommendations for the consumption of fruits and vegetables as seven to ten daily servings, and statistically significant increase in reducing eating barriers of fruit and vegetables after the intervention [24].

B. Interventional studies without the use of health education theories and models (Table 2)

Five articles examined the impact of interventions without the use of health education theories and models.

A study by Neville Charlotte and colleagues in Belfast (Northern Ireland) as intervention and control over 80 elderlies took place through inviting them to participate in

Table 2 Summary of interventions to increase fruit and vegetable consumption in older people without the use of theories and models of health education

First author name/Study publishing year	Time and place of study	Purpose of the study	Target group	Sample size	Duration of intervention
Neville Charlotte E/2013	From October 2006 to June 2008/Northern Ireland Belfast)	Effect of the recommended 5 portions FV/day compared to ≤2 portions/day on Measures of muscle strength and physical function. In older adults (before and after)	Elderly 65 to 85 years old were invited to cooperate with the media following: press releases to local media, older people's networks, newsletters and bulletins, presentations to older peoples' community groups and from hospital Outpatient clinics and study participants were at home	41 cases in the intervention group and 39 in the control group	16 weeks
Neville Charlotte E/2014	From October 2006 to June 2008/Northern Ireland Belfast)	Effect of increased fruit and vegetable consumption on bone turnover in older adults: a randomised controlled trial (intervention and control)	Elderly 65 to 85 years old were invited to cooperate with the media following: press releases to local media, older people's networks, newsletters and bulletins, presentations to older peoples' community groups and from hospital Outpatient clinics and study participants were at home	41 cases in the intervention group and 39 in the control group	16 weeks
Gibson Andrew/ 2015	From October 2006 to June 2008 Northern Ireland Belfast))	Effect of fruit and vegetable consumption on immune function in older people: a randomized controlled trial (intervention and control)	Elderly 65 to 85 years old were invited to cooperate with the media following: press releases to local media, older people's networks, newsletters and bulletins, presentations toolder peoples' community groups and from hospital Outpatient clinics and Study participants were at home	41 cases in the intervention group and 39 in the control group	16 weeks
Abusabha Rayane/ 2011	April and October 2008/Cities and urban areas in the region, Troy and Albany, New York	Increasing access and affordability of produce Improves perceived consumption of vegetables in low-income seniors (before and after the intervention)	Elderly with an average age of 69 years for low-income who live in nursing homes places	79 elderly completed the assessment before the intervention, after evaluating 63 patients completed the study. And of these 43 were common in both completed assessments	5 month
Cates Sheryl/ 2014	Between March and July 2012/American senior centers	To assess the impact of the Eat Smart, LiveStrong (ESLS) intervention on low-income older adults' fruit and vegetable consumption) before and after the intervention)	Among seniors Were 60 years and older in senior centers	614 elderly people were studied before and after the intervention	Unknown

Table 2 continued

First author name/Study publishing year	Theory/model	studied variables	How to do intervention	The results of intervention
Neville Charlotte E/2013	–	Interviews with elderly about the history of their dietary intake of fruits and vegetables on a weekly basis by telephone In vitro evaluation of nutrients in the body elderly	Educating Elderly about nutrition per serving of fruits and vegetables according to the Guide to UK Allowing Elderly in purchasing and consumption of fruits and vegetables Encourage Elderly on a variety using fruits and vegetables Discussion with elderly about the methods of production and consumption of fruits and vegetables Question of Elderly in the study of infectious disease or taking supplements	Statistically significant increase in mean consumption of fruit and vegetables in the intervention group than the control group after intervention Statistically significant increase in the mean measurement of nutrients in the intervention group than the control group after intervention No statistically significant difference between in the average daily consumption of fruits and vegetables and evidence on changes in physical function among those who consumed two serving of fruits and vegetables per day, and 5 serving daily Statistically significant increase in mean muscle tone in the intervention group and the control group after intervention
Neville Charlotte E/2014	–	Interviews with elderly about the history of their dietary intake of fruits and vegetables on a weekly basis by telephone In vitro evaluation of nutrients in the body elderly	Educating Elderly about nutrition per serving of fruits and vegetables according to the Guide to UK Allowing Elderly in purchasing and consumption of fruits and vegetables Encourage Elderly on a variety using fruits and vegetables Discussion with Elderly about the methods of production and consumption of fruits and vegetables Question of Elderly in the study of infectious disease or taking supplements	Statistically significant increase in mean consumption of fruit and vegetables in the intervention group than the control group after intervention Statistically significant increase in the mean measurement of nutrients in the intervention group than the control group after intervention No statistically significant difference between in the average daily consumption of fruits and vegetables and evidence on changes in physical function among those who consumed two serving of fruits and vegetables per day, and 5 serving daily

Table 2 continued

First author name/Study publishing year	Theory/model	studied variables	How to do intervention	The results of intervention
Gibson Andrew/ 2015	–	Interviews with Elderly about the history of their dietary intake of fruits and vegetables on a weekly basis by telephone In vitro evaluation of the antibody response to tetanus vaccine and pneumonia in elderly body	Educating Elderly about nutrition per serving of fruits and vegetables according to the Guide to UK Allowing elderly in purchasing and consumption of fruits and vegetables Encourage elderly on a variety using fruits and vegetables Discussion with Elderly about the methods of production and consumption of fruits and vegetables Question of elderly in the study of infectious disease or taking supplements Tetanus and pneumonia vaccination for the elderly at 12 weeks intramuscularly intervention	Statistically significant increase in mean consumption of fruit and vegetables in the intervention group than the control group after intervention Statistically significant increase in the mean measurement of nutrients in the intervention group than the control group after intervention No statistically significant difference between in the average daily consumption of fruits and vegetables and evidence of an increase in antibodies against tetanus in group 2 serving daily consumption of fruits and vegetables daily, and those who are serving 5 after intervention There are statistically significant differences in the average daily consumption of fruits and vegetables and evidence of an increase in antibodies against the pathogen pneumonia vaccine between 5 serving of fruits and vegetables consumed per day compared with 2 serving daily after the intervention
Abusabha Rayane/ 2011	–	Evaluation process to access, purchase and consumption of fruits and vegetables in selected centers after placing machines mobile Examine the benefits and drawbacks of mobile machines Fruit and vegetable seller	Intervention: Educating Elderly about the purchase of mobile machines selling fruit and vegetables Insert mobile machines selling fruit and vegetables near life And sell fruit and vegetables by mobile machines	An increase in the mean consumption of fruit and vegetables in general, among the elderly participating in the intervention, after the intervention than before the intervention No statistically significant increase in mean daily consumption of fruit among the participants in the intervention group after the intervention of entries Significant increase in mean daily consumption of vegetables among participants in the intervention group after the intervention than before the intervention An increase in the purchase of the participants of the mobile machine to stores after intervention

Table 2 continued

First author name/Study publishing year	Theory/model	studied variables	How to do intervention	The results of intervention
Cates Sheryl/2014	–	The primary impactmeasure was increase in participants' average daily intake of fruit and vegetables measured Using food frequencies (Evaluation 1) and 24-h dietary recalls (evaluation 2) Difference-in-difference models were used to estimate programImpact, comparing change across time (baseline and follow-up) in the intervention group with change across time in the comparison group	Intervention to increase fruit and vegetable consumption, nutrition education was held four sessions of 45 min	Evaluation 1: Increased participants' average Daily consumption of fruit and vegetables Evaluation 2: Increased participants Average daily consumption of fruit and vegetables

the study. A study was conducted to examine the effects of fruit and vegetable intake recommendations on muscle strength and physical performance in elderlies. 39 elderlies in the control group with daily consumption of 2 fruits and vegetables serving and 41 in the intervention group with daily consumption of 5 fruits and vegetables serving were randomly selected. In this intervention, training to elderlies about each serving of fruits and vegetables was according to the UK's food guide, the elderlies were free in purchasing and consuming fruits and vegetables, elderlies were encouraged on consumption of variety of fruits and vegetables, discussion has been done by elderlies about the methods to provide and consumption of fruits and vegetables during the study, elderlies were asked questions about infectious diseases or taking supplements. The study included examining the impact of intervention in the form of interviews with elderlies about the history of their dietary intake specially consumption of fruits and vegetables weekly on the phone as well as in terms of laboratory nutrients in the body of the elderly before intervention, 6, 12 and 16 weeks after the intervention. Intervention results showed a statistically significant increase in mean nutrient intake score of fruits and vegetables consumption and an average measurement of nutrient in blood between the intervention group and the control group after intervention, as well as a statistically significant increase in mean muscle score in the group who consumed 5 fruits and vegetables serving. Also it showed statistically significant increase in mean score of muscle in the group which consumed 5 servings of fruit and vegetables. However, statistically significant differences were not observed in mean consumption of fruit and vegetables and evidence of its impact on elderly's physical function who were taking 5 servings of fruits and vegetables daily [25].

A study by Neville Charlotte and colleagues in Belfast (Northern Ireland) as intervention and control over 80 elderly people took place through inviting them to participate in study. A study to examine the effects of fruit and vegetable intake recommendations on bone turnover in elderly people was conducted. 39 elderlies in the control group with 2 daily servings of fruit and vegetables consumption and 41 persons in the intervention group with 5 daily servings of fruits and vegetables consumption were randomly selected. In this intervention, training was given to elderlies in each fruits and vegetables serving, according to the UK's food guide, the elderly were free in purchasing and consuming fruits and vegetables, the elderly were encouraged about the variety of fruits and vegetables, discussion has been done by elderlies about the methods of providing and consumption of fruits and vegetables during the study, elderlies were asked questions about infectious diseases or taking supplements. The study included examining the impact of intervention in the form of

interviews with elderlies about the history of their dietary intake specially consumption of fruits and vegetables weekly on the phone as well as in terms of laboratory nutrients in the body of the elderly before intervention, 6, 12 and 16 weeks after the intervention. Intervention results showed a statistically significant increase in mean nutrient intake score of fruits and vegetables and average consumption and an average measurement of nutrient in blood between the intervention groups than the control group after intervention. However, statistically significant differences were not observed in mean consumption of fruit and vegetables, and evidence of its influence on bone indices taking 5 servings of fruits and vegetables daily [26].

A study by Andre Gibson and colleagues in Belfast (Northern Ireland) as intervention and control over 80 elderlies took place through inviting them to participate in the study. A study was conducted to examine the recommended effects of fruits and vegetables intake on immune function in elderly people. 39 elderlies in the control group with daily consumption of 2 fruits and vegetables serving and 41 elderlies in the intervention group with daily consumption of 5 fruit and vegetable servings were randomly selected. In this intervention, training to elderlies about each serving of fruits and vegetables was according to the UK's Food Guide, the elderlies were free in purchasing and consuming fruits and vegetables, elderlies were encouraged on consumption of variety of fruits and vegetables, discussion has been done by elderlies about the methods of providing and consumption of fruits and vegetables during the study and were asked questions about infectious diseases or taking supplements. And eventually elderly at each week received 12 of muscular interventions as tetanus and pneumonia. The study examined the impact of intervention in the form of interviews with elderlies about the history of their dietary intake specially consumption of fruits and vegetables weekly on the phone as well as in terms of laboratory nutrients in the body of the elderly before intervention, 6, 12 and 16 weeks after the intervention. Also in vitro evaluation of the antibody response to tetanus and pneumonia vaccine in elderly bodies was measured. Intervention results showed a statistically significant increase in mean nutrient intake score of fruits and vegetables consumption and an average measurement of nutrient in blood between the intervention group and the control group after intervention, statistically significant difference was observed in the daily average consumption of fruits and vegetables and evidence of an increase in antibodies against the pneumonia pathogen in the intervention group. However, statistically significant differences were not observed in mean consumption of fruit and vegetables, and evidence of its impact on the increase in antibodies against tetanus taxied in the group who consumed daily 5 servings of fruits and vegetables (experimental group) [27].

A study was done by Abusabha Rayane et al. in the cities of Troy and Albany and in the two town area in the region of New York metropolitan as before and after the intervention on the elderly in nursing homes. A study was done to examine the effects of nursing access in increasing the consumption of fruits and vegetables. 79 elderly completed the assessment before the intervention, after 63 completed the assessment after the intervention. And of these, 43 were common in both and completed the assessments. The intervention was done as putting the mobile machines selling fruit and vegetables near their living that these mobile machines sell the fruits and vegetables. Educating elderliness about purchasing from mobile machines selling fruit and vegetables, as well as check for access, purchase and consumption of fruits and vegetables in selected centers and after placing the mobile machines and the benefits and barriers for mobile machines selling fruit and vegetable before and 5 months after the intervention were compared. Intervention results showed a statistically significant increase in consumption of fruits and vegetables score between the intervention group after intervention, as well as showed a statistically significant increase in mean daily consumption of vegetables among participants in the intervention group after performing intervention than before the intervention. There was also increase in participants purchasing from mobile machine seller than shops after the intervention. However, there was no statistically significant increase observed in mean consumption of fruit and vegetables, participating in the intervention after the intervention [28].

A study by Cates Sheryl and colleagues was done in America's cities as before and after the intervention on the elderly in nursing homes. The study of "To assess the impact of the Eat Smart, Live Strong (ESLS) intervention on low-income older adults' fruit and vegetable consumption" has been done. 614 elderly people were studied before and after the intervention. Intervention was to increase fruit and vegetable consumption, nutrition education and held four sessions of 45 min. Studies include "The primary impact measure was increase in participants' average daily intake of fruit and vegetables measured, using food frequencies (Evaluation 1) and 24-h dietary recalls (Evaluation 2). Difference in-difference models were used to estimate program impact, comparing change across time (baseline and follow-up) in the intervention group with change across time in the comparison group" Before and an unspecified time after the intervention were compared. The results of intervention in two evaluation phases include: Evaluation 1: increased participants' average daily consumption of fruit and vegetables and Evaluation 2: increased participants' average daily consumption of fruit and vegetables [29].

Discussion

In this systematic review, studies were performed on the consumption interventions of fruits and vegetables in elderlies. According to the researcher's classification, ten review studies and five interventional studies evaluate the consumption of fruit and vegetables in the elderly without health education models and health promotion and five interventional studies evaluate the consumption of fruit and vegetables in the elderly with health education models and health promotion.

Among the five studies which was carried out with models and theories of health education, three studies of stages of change theory TTM were used [20, 21, 23]. The results of intervention showed statistically significant differences in the elderlies advancing mean scores among changing process from pre-contemplation stage and contemplation toward preparation stage (motivation) (and more active) on the consumption of fruit and vegetables as well as statistically significant differences for fruit and vegetables in the intervention and control groups after intervention. In these studies, the intervention procedures were specifically mentioned. But the intervention duration in three interventions due to the changing process from TTM theory was considered less than 6 months, because the least possible time to reach the stage of behavior change according this pattern should be 6 months and according to consumption behavior of fruit and vegetables in the elderly does not appear appropriate. But the good results of these interventions can be influenced by the rigorous training program based on placing people in each of the stages of changing model and the use of theoretical framework for education and increased consumption of fruits and vegetables in the elderly.

Another interventional study has been done by the Health Belief Model which examined the consumption of fruit and vegetables in the elderly [24]. This study also gained desirable results in terms of increased consumption of fruit and vegetables in elderliness. In this study, how to do intervention was described completely and in detail. Instruction time for each meeting was specified, and also the intervening period since the pattern is HBM is considered 4 months that due to the individual behavior of fruits and vegetables consumption in the elderlies, it appears to be appropriate. The favorable results of this intervention could be affected by the rigorous training program based on Health Belief Model and the use of various structures of this model such as self-efficacy as well as scientific and standards guidelines in this field. For the better effects of this study, we could have used the control and intervention group instead of studying before and after intervention.

As well as other interventional studies have been done based on various theories such as behavioral changing theories, communication theories, and social marketing principles [22]. In this intervention, the study was fully listed. In each group learning method based on the use of the models and theories of health education and health promotion, in these studies, the intervention procedures were specifically mentioned. Training method in each studied group was based on the use of the models and theories of health education and health promotion, even in the end of intervention, the studied groups were evaluated economically in terms of cost-effectiveness, it also determined and have followed good results. The favorable results of this intervention could be affected by the rigorous training program based on the use of theoretical frameworks for training and the appropriate models integration in terms of increasing consumption of fruit and vegetable proportional to the condition of the elderly.

Among the five studies carried out without models and theories of health education, three studies were almost done with a similar method [25–27], but their intervention had also a slight difference. The intervention procedure was noted in each intervention. But the number of meetings and training session was unknown. But the intervening period in three stages was marked after the intervention. But the favorable results of this intervention could be affected by the intervention of the elderly in their homes and due to the condition of the elderly. Increasing nutrients material in the blood of elderlies, muscle strength in the elderly, the body's antibodies production to pneumonia were found in older people who consumed 5 daily servings of fruits and vegetables, due to assessment after 16 weeks of study, which is relatively long. But these had no effect in the physical performance status, bone turnover situation, antibodies production to tetanus which can be the cause of this is that this subject addition to fruits and vegetables consumption, is linked to many other factors and conditions and during the follow-up intervention to investigate the effect is also not enough and takes longer. If exact model and theories had been used for trainings it would have been more effective and increased the impact of these interventions. However, it can also emphasize and use training based on the wishes and interests of the elderly.

Rayane, and his colleagues studied the intervention based on placing the mobile machines selling fruit and vegetable near the elderlies' home sites [28], which showed that there is no significant increase in the consumption of vegetables and fruit there. So that it can intervene because it is not explained how mobile machines and what kind of fruit and vegetables should they sell. Even the use of motivational theory and social marketing principles could lead to a significant increase in the consumption of fruit

and brings the desired results. In the study of Cates and his colleagues [29] the intervention procedure was mentioned and the two types of evaluation were considered to intervene. The results showed only increased consumption of fruit and vegetables and increasing nutrient index in the blood of older people and their physical performance was not specified. The results of this study suggest that the use of control group and intervention and using theoretical framework for training and improving the performance of fruit and vegetable consumption and impact on other aspects of health has better outcomes.

Conclusions

Training for consumption of fruits and vegetables to elderlies who are at risk for a variety of digestive problems and chronic diseases related to diet pattern including obesity, abnormal lipid pattern, impaired glucose tolerance, mellitus diabetes and high blood pressure is an appropriate lever for reducing risk factors and prevention of chronic diseases; and even their health and longevity is affected. Long-term training in addition to environmental changes is needed to improve the blood and health indices of older people. Another point which resulted by this systematic review was the use of theoretical frameworks and models of health education as means to increase the utility of interventions in the field of consuming fruits and vegetables for the elderly, achieving better results can be effective. Having models and theories of education can increase the impact of education. According to the characteristics and conditions of the training audience and their favorite and using increasing method of consumption of fruits have positive impact on consumption of fruits and vegetable and their health. In general we can say that health education has a considerable impact on increasing fruit and vegetable consumption in the elderly.

Compliance with ethical standards

Conflict of interest None.

Human and Animal Rights statement This article does not contain any studies with human participants or animals performed by any of the authors.

Informed consent statement For this type of study informed consent is not required.

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