



# Fiber Consumption in Constipated Older Adults; a Theory-Based Interventional Study



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## ABSTRACT

**Aims** This study aimed to assess the effectiveness of an intervention on fiber consumption, self-efficacy, perceived benefit, and barriers among the elderly using the Trans-theoretical Model (TTM).

**Materials & Methods** This quasi-experimental study was developed among constipated elderly people aged  $\geq 60$  in Karaj, Iran, between 2019 and 2021. Constipated participants were randomly assigned to the intervention ( $n=66$ ) or the control ( $n=64$ ) groups. Before and after four educational sessions, demographic information, participants' stages of change for diet, self-efficacy, decisional balance, and daily amount of fiber consumption were evaluated. An analysis was performed to assess any differences in the stages of change (posttest vs. baseline).

**Findings** The perceived barriers and self-efficacy were statistically significant after intervention ( $p<0.001$ ) in the intervention group compared to the control group ( $p>0.001$ ). In both groups, perceived benefits changed statistically significantly ( $p<0.001$ ). Pearson correlation also showed a significant correlation between stages of change and benefits, barriers, self-efficacy, and fiber consumption. The analysis of variance adjusting for covariates also indicated significant differences between intervention and control groups.

**Conclusion** The TTM is a useful model that can be applied to dietary behavior change, specifically fruit and vegetable consumption among elderly populations.

**Keywords** Aged; Constipation; Dietary Fiber; Health Education; Transtheoretical Model

## CITATION LINKS

[1] Knowledge and attitudes regarding dietary fibres: A consumer ... [2] Dietary fiber intake and total mortality: A meta-analysis ... [3] Review of whole grain and dietary fiber recommendations ... [4] Dietary fibre in Europe: Current state of knowledge on definitions, ... [5] Nutrition in the elderly: role of ... [6] Health benefits of dietary ... [7] Consumption of fruit and vegetables among elderly people: A cross ... [8] The phenomenon of population aging in ... [9] Is there any association between overweight, physical activity, fat and fiber ... [10] Prevalence of, and risk factors for, chronic idiopathic constipation in the community: Systematic ... [11] Effect of dietary fiber on constipation: A meta ... [12] Chronic constipation: current treatment ... [13] The effect of lifestyle modification on severity of constipation and quality of life of elders ... [14] Assessment and management of constipation in older people: Sue ... [15] Theories of behaviour and behaviour change across the social and behavioural ... [16] Factors behind fruit and vegetable consumption among the elderly ... [17] Does the transtheoretical model of behavior change ... [18] Promoting fruit and vegetable consumption: Methodological protocol ... [19] Applying the stages of change model in a nutrition ... [20] The transtheoretical model of health ... [21] Fat reduction efforts: A 24-month longitudinal ... [22] The relationship between process use and stage of ... [23] The transtheoretical model is an effective ... [24] Assessing dietary and exercise stage of change to optimize ... [25] Transtheoretical model-based nutritional ... [26] A dish-based semi-quantitative food frequency ... [27] Perceived benefits and barriers of increased ... [28] A premature obituary for the transtheoretical ... [29] Stages of change in fruit intake: A longitudinal ... [30] Increasing fruit and vegetable intake in homebound ... [31] Increased fruit and vegetable intake among older adults ... [32] Behavioural counselling to increase consumption of fruit ... [33] Testing the transtheoretical model for ... [34] Interventions directed at eating habits and ... [35] Effects of dietary fiber and its components on metabolic ... [36] The application of transtheoretical model to identify ... [37] Transtheoretical model stages of change for dietary ... [38] Knowledge, barriers, and stage of change as ...

## Introduction

A high-fiber diet can decrease the risk of some chronic diseases, such as cancer and coronary heart disease, considering its crucial effect in preventing obesity [1]. Evidence showed an 11% reduction (95% CI 0.85-0.92) in all-cause mortality for each 10g per day increment in the consumption of dietary fiber [2]. The recommended amount of fiber is about 25g daily [3]. Evidence shows that many people consume less than this amount across the world. Actual daily fiber intake in European countries is 18-24g and 16-20g for men and women, respectively [4]. Dietary guidelines and food guide pyramid for elderly people highlight the necessity to increase dietary fiber intake [5]. Some health benefits of increased fiber consumption among the elderly include decreasing high blood pressure, improving bowel regular movements, reducing constipation, and preventing blood sugar [6]. Studies show that the mean number of fruit and vegetable servings in the Iranian elderly population is 1.76 from at least five servings recommendation [7], while the elderly population in Iran is increasing [8].

Studies show low dietary fiber intake is associated with constipation [9]. A high-fiber diet can increase stool weight, decreasing colon transit time, while a poor-fiber diet induces constipation [10]. There is a significant difference between the defecation frequency in fiber consumers in the intervention and control groups. (OR=1.19; 95%CI: 0.58-1.80), with no significant difference between laxative therapy and placebo groups from the pooled analysis of two studies (OR=1.07; 95%CI 0.51-2.25) [11]. Lifestyle modification is well-documented and recommended by authors as a first-line therapy for constipation [12-14].

There is an emphasis on applying theory-based interventions to adopt healthy behaviors [15]. It is well-documented that constructs of these models predict fruit and vegetable consumption among the elderly [16]. Among the studies that tried to improve fruit and vegetable consumption behavior, the TTM model has been effective [17-19]. The TTM assumes that behavior change occurs through the following five stages: Pre-contemplation (Unaware of behavior change and not intending to change behavior), contemplation (Intending to change behavior in six months), preparation (Planning some steps for behavior change), action (Intending to take action in the next month), and maintenance (Acting behavior for six months) [20]. The TTM acts on the assumption that individuals do not change behaviors quickly and decisively. Rather, change in behavior, especially habitual behavior such as food consumption, occurs continuously through a cyclical process. Fiber consumption as a food intake behavior follows a similar pattern. Therefore, when individuals, especially older people, want to change their dietary behavior, a sudden change in diet may not be

successful. Therefore, dietary interventions will be useful if organized according to the stages of change presented in the TTM.

Although TTM is widely applied to treat various health behaviors, such as percentage of body fat [21], and sugar [22], there is little evidence of its effectiveness in fiber consumption. Most evidence shows a reduction in weight and body mass index [23], increased physical activity, and improved cholesterol levels and glycemia [24]. A systematic review showed that nutritional interventions based on TTM included fruit and vegetable consumption, a low-fat diet, and cooking skills [25].

As elderly with constipation experience symptoms at an older age, there is potential to test the feasibility and effectiveness of a tailored intervention according to their stage of change for improving health-related behavior. Therefore, the study aimed to assess the effectiveness of an intervention study on fiber consumption among the elderly using the TTM model.

## Materials and Methods

### Design

This quasi-experimental study was conducted among elderly people aged  $\geq 60$  in Karaj, Iran, from 2019 to 2021. Data were collected during two phases. During the first phase, constipated individuals were identified using the Wexner Constipation Scoring System (WCSS). Identified participants were then randomly assigned into two groups using simple random sampling. The inclusion criteria were; a) being more than 60 years old, and b) obtaining a score of 11 and more from WCSS. The exclusion criteria were defined as; a) having gastrointestinal cancer, and b) undergoing under any nutritional regime.

### Sampling

Out of 36 existing health centers in Karaj, 10 centers were randomly selected through a multistage sampling method to represent centers from both main areas in Karaj (5 centers from the east and 5 centers from the west). Within the 10 selected centers, the membership list for each center was consulted, and a systematic sampling method was used to select elderly individuals from each center. The selected participants were contacted and asked if they would participate in the study. Participants were also informed about the study and the number of required meetings during the study. Then participants were assessed concerning constipation. Finally, constipated participants were randomly assigned to the intervention (n=66) or the control (n=64) groups. A health professional not connected to the study carried out the randomization.

### Data gathering

Data was collected at baseline and four weeks follow-up. At baseline, face-to-face interviews were conducted with the whole sample using a structured

questionnaire including demographic information, participant's stages of change for diet, self-efficacy, decisional balance, and daily fiber consumption. Four weeks of follow-up data were collected after implementing the intervention. If an individual was absent for two educational sessions, used laxatives, or used constipation-causing medications, they were excluded from the study. We also excluded individuals who underwent any abdominal surgery during the study. Such medications include antipyretic drugs (e.g., morphine and codeine), anticholinergic drugs (Hyoscine), antidepressants (Imipramine and fluoxetine), antiepileptic drugs (e.g., phenytoin and carbamazepine), antipsychotics (Haloperidol and clozapine), and food supplements containing iron and calcium.

Data was gathered using the following tools and scales

#### **Demographic and anthropometric questionnaire:**

The demographic section of the questionnaire included age, gender, education, income, marital status, gastrointestinal diseases (having or not), and body mass index (BMI). Weight was measured using the same calibrated digital scales while the participants were minimally clothed and not wearing shoes. Height was measured by a tape measure while the respondents were standing and not wearing shoes, and the shoulders were in a normal position. BMI was computed using the formula  $\text{weight}/(\text{height})^2$ ; income status was measured by asking the participants their monthly income (In terms of Iranian currency), and then, using the social context, dividing the participants into three groups (Low, medium, high).

#### **Stage of readiness for fiber intake**

This questionnaire section was developed based on a previous study [26] and a focus group with a subsample (n=14) of Iranian elderly. It included five statements by which the participants were categorized into different stages of change: Pre-contemplation, contemplation, preparation, action, and maintenance. The participants were asked to choose the statement that best described their status by selecting multiple-choice options. Choices for the questions were (1) "I currently do not eat enough high-fiber foods, and I am not thinking about starting"; (2) "I currently do not eat enough high-fiber foods, but I am thinking about starting"; (3) "I currently do not eat enough high fiber foods, but I plan to do so within the next month"; (4) "I currently eat enough high fiber foods, but I have only begun to do so in the last six months", and (5) "I currently eat enough high fiber foods, and I have done so for longer than six months". Since dietary fiber is not a tangible concept, we explained the concept of fiber-rich foods using examples, pictures, and recommended amounts before choosing the stage. The internal consistency of the questionnaire was assessed using Cronbach's alpha coefficient and found to be 0.80

#### **Self-efficacy for a healthy diet**

This section evaluated participants' confidence in their ability to persevere in their fiber consumption goals despite unfavorable circumstances. It was developed based on the questionnaire developed from focus groups with a subsample of elderly. This part consisted of five items: "I can use a healthy diet to increase fiber even if it takes a long time", "I can use a healthy diet to increase fiber even if I eat out", "I can use a healthy diet to increase fiber even if I do not get much support from others", "I can use a healthy diet to increase fiber even if I have to have a detailed daily plan", and "I can use a healthy diet to increase fiber even if it is expensive".

Each item was scored on a 5-point scale (From not at all confident=0 to very confident about fiber consumption). The total score ranged from 5 to 25, with higher scores indicating greater self-efficacy. A test-retest evaluation was done among 30 constipated old people at two-week intervals. The Intra-class correlation coefficient was calculated as 0.73. The Cronbach's alpha coefficient for this scale was calculated as 0.81.

#### **Perceived benefits and barriers related to fiber consumption**

This part was based on a previously validated questionnaire [27]. The participants' perception of the advantages of increased fiber consumption was assessed using nine items; each scored on a 5-point Likert scale ranging from very important to unimportant. The perceived barrier segment consisted of 5 items. Each item was also rated on a 5-point scale ranging from very important to not important. The total score for the perceived benefits ranged from 9 to 45, and for perceived barriers, 5 to 25. The Cronbach's alpha coefficient for the benefit scale was 0.75, and for the barrier scale, it was 0.71.

#### **Fiber Consumption**

##### **Food Frequency Questionnaire**

The dietary fiber intakes of study participants were examined using a validated 106-item semi-quantitative Food Frequency Questionnaire (FFQ), as described elsewhere in detail [26]. The participants were asked to determine, "How often have you consumed the listed products in the past week?". The FFQ was administered with a photo album of foods for more reliable data. Daily fiber intakes for each participant were estimated based on the US Department of Agriculture food composition database, modified for Iranian foods.

##### **A 24-hour recall**

The participants were asked to estimate their daily amount of fiber at breakfast, lunch, dinner, and between meals as snacks or desserts in accordance with nutrition guideline charts. Appropriate food models were used to estimate the portion size of each food and food item. Participants were asked to indicate how often they consumed a selected list (30 items) of high-fiber foods.

**Intervention**

The participants in both groups received four educational sessions. The educational session interval was one week (A session per week). The educational content in the control group focused on general health education, while the educational content of the intervention group focused on increasing fiber intake. People received four consecutive educational sessions. Each one lasted 60 minutes and included a 30-minute motivational PowerPoint presentation with opportunities for questions and answers, along with 30 minutes of group discussion at the end of each session; each group enjoyed a reception with fiber-rich foods, especially a traditional meal called Ash or Aush which is one of the most famous and delicious Iranian foods. Ash food is usually cooked with various ingredients, mostly vegetables and legumes (Such as beans, lentils, chickpeas, mung beans, barley, and wheat).

I) The first session introduced high-fiber foods.

II) The second session included the participant's stages of change assessments for fiber intake. During this session, the appropriate educational intervention was delivered to the participants according to each individual's stages of change assessment. A tailored technique based on the Trans theoretical Model was applied.

II-a) Participants in the pre-contemplation stage completed the educational session consisting of consciousness-raising (Increasing their knowledge related to fiber consumption); dramatic relief (Reacting emotionally to warnings regarding low fiber consumption), and goal setting (Planning to reach 25gr/day fiber intake per day). As individuals in the Pre-contemplation stage are uninformed or under-informed about the consequences of their behavior, the intervention for these groups included some educational material to improve their knowledge. We also focused on motivational strategies, such as providing short movies comparing the excretion of a fiber-rich diet in the colon with other foods. For this change process, sharing experiences regarding losing a loved one due to a chronic disease (e.g., CVD: Cardiovascular disease) and discussing the association between this disease and fiber intake was used to increase emotional arousal. Emotional arousal is a technique that leads to increased emotional experiences that promote people toward fiber consumption. This technique was used to assist the study subjects in understanding the association between a lower fiber intake and a higher risk of chronic disease. For this purpose, researchers indicated the prevalence rate of chronic diseases in the world and Iran. Then they shared scientific reports on the protective effect of fiber consumption against chronic disease.

II-b) Participants in the contemplation/preparation stage completed the educational session that focused on self-evaluation (Assessment of one's self-image with and without a specific unhealthy behavior). The

researcher asked the participants who were now consuming adequate fiber to compare their lifestyle and diet before and after increasing their daily fiber intake; This group also focused on self-liberation, which is the belief that one can change and have the commitment to act on that belief. Participants were asked to make a plan, set a goal and be committed to that goal.

III) During the third session, the content of the second session was emphasized.

IV) The fourth session was planned to help participants do three things: Anticipate and overcome barriers, increase their self-efficacy, and improve skills in obtaining adequate fiber.

To improve self-efficacy, we used four strategies proposed by Bandura and documented in patients with chronic conditions, including adopting step-by-step fiber consumption, using verbal persuasion, applying a role model using vicarious experience, and anxiety coping.

**Statistical Analysis**

The characteristics of participants in the two groups were compared using an analysis of variance, t-tests, and Chi-square tests as appropriate. Responses to the interventions were assessed by calculating changes in fiber intake from baseline to 4 weeks.

An analysis was performed to assess any differences in the stages of change (Posttest vs. baseline). The data were analyzed on an "intention to treat" basis, including all 400 participants. Analysis of covariance (ANCOVA) was used, controlling for variables previously shown to be related to fiber consumption, namely, age, education, marital status, income, gastrointestinal disease, and BMI. SPSS 19 software was used for data analyses.

**Table 1.** Frequency (numbers in parentheses are percentages) of the samples according to demographic characteristics

Parameter	Intervention group (n=66)	Control group (n=64)	p Value
<b>Age (year)</b>			
60-64	16 (24.24)	17 (26.56)	0.897
65-69	37 (56.07)	44 (68.75)	
70-73	13 (19.69)	3 (4.69)	
<b>Sex</b>			
Male	31 (47)	32 (50)	0.730
Female	35 (53)	32 (50)	
<b>Education (year)</b>			
<12	27 (40.91)	27 (42.19)	0.101
12	28 (42.4)	24 (37.5)	
>12	11 (16.7)	13 (20.31)	
<b>Occupation</b>			
Employed	8 (12.12)	14 (21.88)	0.095
Retired	26 (39.39)	29 (45.31)	
Housewife	32 (48.48)	21 (32.81)	
<b>Marital status</b>			
Married	46 (69.70)	49 (76.56)	0.079
Unmarried/Widow/Divorce	20 (30.30)	15 (23.44)	
<b>Income</b>			
High	34 (51.51)	41 (64.06)	0.147
Medium	22 (33.33)	18 (28.13)	
Low	10 (15.15)	5 (7.82)	
<b>Gastrointestinal disease</b>			
Yes	13 (19.69)	14 (21.87)	0.76
No	53 (80.30)	50 (78.13)	

**Findings**

Out of 238 elderly constipated people, 164 were recruited into the study and allocated randomly to two 82 individual groups. 34 individuals were excluded due to not participating in the education process (n=14), having abdominal surgery during the study (n=2), and not willing to continue (n=18). Finally, data analysis was conducted with 130 persons (66 in the intervention group and 64 in the control group). There was no significant difference between the age of the intervention group (67.14±35.59 years) and the control group (66.20±3.42 years; Table 1).

At baseline, there was no difference between the intervention and control groups in the studied parameters, but after the intervention, the differences were significant in the intervention group (Table 2).

**Table 2.** Comparison of the mean of perceived benefits, perceived barriers, self-efficacy, and fiber consumption between and within groups

Parameter		Intervention	Control	p Value
<b>Perceived Benefits</b>	Before	16.15±5.73	14.41±4.84	0.063
	After	38.15±6.95	14.20±4.40	<0.001
	p Value	<0.001	<0.001	
<b>Perceived Barriers</b>	Before	22.25±2.69	22.50±2.98	0.617
	After	21.56±2.99	22.30±2.63	<0.001
	p Value	<0.001	0.083	
<b>Self-Efficacy</b>	Before	9.39±6.74	9.64±4.26	0.804
	After	24.64±4.81	9.46±6.70	<0.001
	p Value	<0.001	0.058	
<b>Fiber Consumption</b>	Before	8.72±2.23	9.21±3.91	0.385
	After	21.46±3.75	10.39±3.38	<0.001
	p Value	<0.001	0.64	

Pearson correlation showed significant correlations between stages of change and benefits, barriers, self-efficacy, and fiber consumption (Table 3).

**Table 3.** Correlation between stage of change, benefits, barriers, self-efficacy, and fiber consumption (all significant at p<0.01)

Parameter	5	4	3	2	1
<b>1-Stages of change</b>	0.485	0.353	-0.205	0.313	1
<b>2-Benefits</b>	0.644	0.389	-0.170	1	
<b>3-Barriers</b>	-0.285	-0.213	1		
<b>4-Self-efficacy</b>	0.606	1			
<b>5-Fiber consumption</b>	1				

The elderly in the intervention group had higher fiber intake, perceived benefits, self-efficacy, and lower perceived barriers (Table 4).

There was no difference at baseline in the distribution of the stages of change in fiber intake

between the two groups. Before the intervention, more participants fell into the pre-contemplation stage than the other stages. None of the participants consumed the recommended 25g/day of fiber. Compared with the control group, a greater proportion of elderly individuals in the intervention group moved from pre-contemplation to contemplation/preparation ( $\chi^2=44.133$ ;  $p<0.001$ ). There was not any progress from preparation to action (Table 5).

**Table 4.** Analysis of covariance of perceived benefit, perceived barrier, self-efficacy, and fiber consumption

Source of variance	of Type III sum of square	df	Mean Square	F	p Value
<b>Perceived Benefits</b>					
Arm	0.196	1	0.196	0.007	0.932
Pretest	119.529	1	119.529	4.443	0.039
Age	631.778	12	52.648	1.957	0.042
Sex	20.888	1	20.888	0.776	0.381
Education	204.502	4	51.125	1.900	0.120
Marital Status	101.247	2	50.624	1.882	0.160
Income	618.203	8	77.275	2.872	0.008
Gastrointestinal Disease	105.625	1	105.625	3.926	0.052
BMI	1160.385	27	42.977	1.597	0.062
Error	1829.476	68	26.904b		
<b>Perceived Barriers</b>					
Arm	0.405	1	0.405	0.035	0.853
Pretest	48.665	1	48.665	4.174	0.045
Age	84.744	12	7.062	0.606	0.830
Sex	0.007	1	0.007	0.001	0.981
Education	3.877	4	0.969	0.083	0.987
Marital Status	7.100	2	3.550	0.304	0.739
Income	41.633	8	5.204	0.446	0.889
Gastrointestinal Disease	3.353	1	3.353	0.288	0.594
BMI	168.335	27	6.235	0.535	0.964
Error	792.908	68	11.660		
<b>Self-Efficacy</b>					
Arm	19.250	1	19.250	0.322	0.573
Pretest	388.694	1	388.694	6.493	0.013
Age	569.851	12	47.488	0.793	0.656
Education	260.563	4	65.141	1.088	0.369
Marital Status	46.687	2	23.344	0.390	0.679
Income	318.983	8	39.873	0.666	0.719
Gastrointestinal Disease	0.610	1	0.610	0.010	0.920
BMI	1057.310	27	39.160	0.654	0.889
Error	4070.979	68	59.867a		
<b>Fiber Consumption</b>					
Arm	48.340	1	48.340	7.160	0.009
Pretest	2.800	1	2.800	0.415	0.522
Age	160.710	12	13.392	1.984	0.039
Education	63.711	4	15.928	2.359	0.062
Marital Status	5.987	2	2.993	0.443	0.644
Income	117.778	8	14.722	2.181	0.040
Gastrointestinal Disease	1.243	1	1.243	0.184	0.669
BMI	457.204	27	16.933	2.508	0.001
Error	459.095	68	6.751a	459.095	

**Table 5.** Chi-square analysis of between-groups differences in pre-test stages of change in comparison with post-test

Phase	Pre-Contemplation	Contemplation	Preparation	$\chi^2$ (df)	p Value
<b>Pre-test</b>					
Intervention	45	17	4	1.245 (2)	0.537
Control	39	18	7		
<b>Post-test</b>					
Intervention	8	16	42	44.133 (2)	<0.001
Control	37	20	7		

## Discussion

This study indicated the efficacy of a TTM-based intervention for improving fiber consumption in the elderly. The findings also confirmed that theory-based interventions could affect stages of change among elderly populations in elderly to promote progress in making healthy lifestyle choices. We considered a 4-session educational series to promote progress from one stage to the next. According to Diclement *et al.*, people can advance between stages within a single session intervention [28]. This study confirmed that the stage of change among participants is an important concept that must be assessed before intervention to determine which intervention is most appropriate.

We considered for FFQ the frequent foods consumed for one week because, according to the previous longitudinal investigation related to fruit consumption, stage movement can occur within a short time, even as short as three days [29].

While the current study was conducted on the elderly, previous investigators have shown that interventions to promote fruit and vegetable consumption among elderly populations have generally been successful, regardless of where the individuals live [30].

In this study, patients are categorized into the following groups according to the TTM model: In the pre-contemplation, subjects have no intention of changing their fiber intake in the foreseeable future or are not aware of having a problem; in the contemplation, constipated elderly are aware that they have a problem with constipation and low fiber intake and are seriously thinking about resolving it, however, not in the near future; in the preparation stage, the decision-making stage, subjects have made the commitment to take action within the next 30 days; and in the action stage, subjects make notable overt efforts to improve fiber intake adequately. As each patient received a tailored education according to her/his recognized stage, generally, they moved from pre-contemplation to preparation.

In this study, the findings were quite satisfying in the intervention group. We found an average increase of  $12.74 \pm 1.52$  grams of fiber per day in the intervention group. The results from the current study were similar to those reported by other investigators. For instance, an interventional study that applied the Color Your Plate with Fruits and Vegetables Intervention showed that fruit and vegetable intake in the elderly increased by  $3.74 \pm 2.38$  [31]. Another study reported a significant increase in fruit and vegetable consumption; a 1.49 serving/day increase when using a theory-based intervention [32]. The current study used a stage-matched intervention which is more successful than non-stage-matched interventions [33].

A systematic review study identified 28 studies of interventions targeting eating behaviors that showed

positive outcomes such as reduced fat intake, increased consumption of fruits and vegetables, and increased physical activity [34]. Similarly, our findings demonstrated that a tailored intervention according to the stage of change positively affected perceived benefits and barriers as well as self-efficacy.

The current study found that most participants fell into pre-contemplation before the study, and no participants met the threshold of recommended daily fiber (25gr/day) [35]. Studies also showed that most participants were in pre-contemplation stages related to fruit and vegetable consumption [36]. Similar to previous studies [37], our findings indicated that most participants are not ready to change their behavior.

In the current study, progress toward the later stages of change was associated with a significant increase in fiber consumption. The association between stages of change and self-efficacy was also expected as the TTM indicates that moving forward through the stages of change shows a better self-efficacy to adopt healthy behavior. In our study, there was a greater fiber consumption in the higher stage of change. This finding is consistent with previous research that found higher levels of fruit and vegetable consumption in individuals at a more advanced stage of change [38].

Results indicated that participants in the present study were in lower stages of change and that no participants were in the action or maintenance stages. To the best of our knowledge, this study also stands out for assessing, for the first time in Iran, consumption of fiber, stage of change, and self-efficacy in adopting healthy eating practices simultaneously. In this way, this research can help develop nutritional interventions aimed at the elderly. This shows the necessity of educational interventions to help people progress in the stages of behavior change and increase their intake of fruits and vegetables.

Overall, most intervention studies based on the TTM model showed that the interventions have positively influenced fruit and vegetable intake, and to our knowledge.

This study was impacted by the following limitations: a) a one-week interval time may be considered too small to study stage progress and behavioral changes. b) Data was collected using a self-administered questionnaire. Self-reported responses may be exaggerated; respondents may be over/underestimated to disclose private details, and various biases may affect the results. c) This study did not follow up with the participants over a long period because it was retrieved from the MSc thesis, and it was impossible to follow the participants for longer periods. d) Due to the inclusion criteria in the recruitment of constipated patients, it is not surprising that none of the participants were in the action category of TTM. This led to the fact that we

could not implement intervention for people in the action stage to move forward to the maintenance stage. Further studies are recommended to incorporate the TTM model to manage unhealthy behaviors in the elderly population.

## Conclusion

The TTM is a useful model that can be applied to dietary behavior change, specifically fruit and vegetable consumption among elderly populations.

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**Ethical Permissions:** The ethics committee of Alborz University of Medical Sciences approved the study (Ethical code no. IR.ABZUMS.REC. 1398.223). A written consent form was obtained from all participants

**Conflicts of Interests:** The authors declare no conflict of interest.

**Authors' Contribution:** Ghanbari M (First Author), Introduction Writer/Assistant Researcher (10%); Rajati F (Second Author), Assistant Researcher/Statistical Analyst (30%); Salehi L (Third Author), Introduction Writer/Methodologist/Main Researcher/Discussion Writer (60%)

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