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ORIGINAL ARTICLE

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Fluid intake, fiber consumption, and physical activity related to constipation among elderly, which one is more important? A cross-sectional study in Iran

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ABSTRACT

Background: Chronic constipation is a common, self-reported, and symptom-based disorder which can significantly influence an individual's health-related quality of life and imposes several financial costs.

Aims: The present study aimed to evaluate the effect of water consumption, fiber intake, and physical activity (PA) on constipation, and which one is more critical by considering the mediating effect of BMI.

Subjects and Methods: This cross-sectional study involved 400 older adults in 2019 referring to the comprehensive health service centers in Karaj, the capital of Alborz province. The data were collected using the questionnaires of demographic and anthropometric characteristics, PASE (Physical activity for elderly), fluid intake, FFQ (Food Frequency questionnaire), Wexner constipation, and Persian lifestyle questionnaire analyzed using SPSS and LISREL software.

Results: Based on the final fitted model, PA is the most critical constipation-related factor compared to the fluid intake and fiber consumption. In addition, fiber consumption is the second crucial factor affecting constipation, and there is a negative association between constipation and fiber intake.

Conclusion: As price is one of the barriers to fiber consumption among the elderly, the recommendation to do physical activity such as walking to solve constipation is efficient and inexpensive for individuals with different socio-economic status.

Keywords: Physical activity, Wexner constipation, fiber consumption, elderly, Iran.

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1 INTRODUCTION

Aging is a worldwide phenomenon (Ismail *et al.*, 2021). Iran, like other countries, encounters acceleration in the number of elderly people. The proportions of the older adults in Iran exceed 10% of the total population (85 million) in 2022 (Doshmangir *et al.*, 2023). Sixty (60) years old is considered old age in developing countries (Shetty, 2012).

Chronic constipation is a common, self-reported, symptom-based disorder, which can significantly influence an individual's health-related quality of life (Belsey *et al.*, 2010). Constipation affects the quality of life of a person with social issues and imposes financial costs (Mugie *et al.*, 2011).

The prevalence of constipation is estimated to be 1 – 80% around the world (Sanchez & Bercik, 2011). The prevalence increases with age (Higgins & Johanson, 2004) and older people suffer from constipation more than their counter

partner (Harari, 2009). Constipation affects 17 – 40% of the elderly and reduces the quality of life (QOL) (Fosnes *et al.*, 2012; Rao & Go, 2010).

Chronic constipation is a symptom-based disorder characterized by unsatisfactory defecation, due to the infrequent stools, difficult stool passage, or both (Forootan *et al.*, 2018). According to Rome Criteria III, suffering from two or more of the symptoms of two or fewer bowel movements per week, strain during defecation, lumpy or hard stools, and feeling incomplete for at least 12 weeks in 12 months determines constipation (Zahedi *et al.*, 2011).

The prevalence among older adults above 65 years old in Iran was 50%, assessed by the criteria of Rome III (Alimoradzadeh & Mokhtare, 2017).

Constipation is related to multiple factors, as the untreated or not adequately treated case results in complications, such as compression or perforation and death (Tariq, 2007). Constipation represents an economic burden for the patient and healthcare provider (Gallegos-Orozco *et al.*, 2012; Zeitoun & de Parades, 2013).

Elderly healthcare providers should be aware of constipation to reduce its resultant complications (Nour-Eldein *et al.*, 2014).

Lifestyle correction is of global worry, which is suggested to prevent and handle several diseases (Harari, 2010), including constipation.

Some factors such as low fluid intake, low fiber consumption, and impaired mobility increase constipation among the elderly (Bharucha *et al.*, 2013; Woo *et al.*, 2015).

Of all the advantages of dietary fiber, probably the most commonly known and appreciated is its impact on constipation alleviation. Several studies support such efficacy, which appears indisputable based on the available evidence. A randomized controlled, double-blind study examined the effects of 'vege-powder' (consisting of chicory, broccoli, and whole grains) on the constipation prevention among 90% of the participants and indicated that those who received vege-powder had a significant reduction in the symptoms of constipation at 2 and 4 weeks (Harari, 2010; Rao *et al.*, 2015). compared with those in the control group. Further, Rao *et al.* in a systematic review study reported that dietary fiber influenced constipation in five of the seven studies, supporting the positive effects of dietary fiber on constipation (Tantawy *et al.*, 2017).

Physical activity has positive effects on the health of Gastrointestinal tract (GIT) (Schuster *et al.*, 2015), as physically active individuals demonstrated a lower prevalence of constipation compared to physically inactive ones (Simrén, 2002).

There is limited evidence that lifestyle changes resolve constipation although it is universally accepted as a first-line approach. The studies assessing the effect of physical activity on constipation among the elderly failed to show an improvement in bowel movements; however, exercise enhanced the quality of life among this population (Robson *et al.*, 2000; Slavin, 2005). Although appropriate physical activity should be considered to improve symptoms of constipation, there is not sufficient strong evidence in this regard (Gandell *et al.*, 2013).

Related to fluid intake, high fiber foods and enough water intake are essential for general health and the dietary treatment of constipation and obesity (Robson *et al.*, 2000).

Promoting fluid intake to improve the symptoms of constipation is not supported by literature (Slavin, 2005). Evidence indicated that low fluid intake is associated with constipation among nursing home residents (Gandell *et al.*, 2013). However, some researchers highlighted that the prevalence of constipation is higher among individuals who do not consume whole grains, fresh fruits, and raw salad daily, which are high fiber foods (Slavin & Lloyd, 2012) and those with inadequate water intake (Alfawaz *et al.*, 2020; Shaheen *et al.*, 2018).

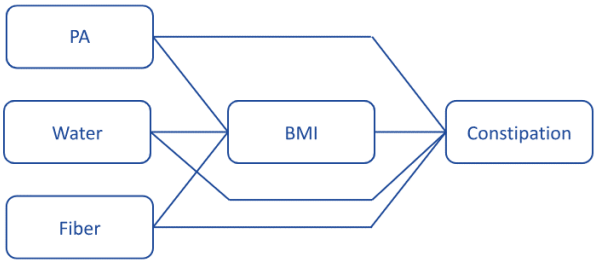
Another study indicated two groups with identical fiber consumption and higher fluid intake led to higher stool frequency compared to lower fluid intake ($p < 0.001$) (Anti *et al.*, 1998).

Inadequate fluid consumption is touted as a common culprit in constipation, and increasing fluid intake is a frequently recommended treatment (Alsheridah *et al.*, 2018).

There is a strong association between obesity and constipation (Alsheridah *et al.*, 2018). Although obesity is also associated with constipation, it is not recognized as a causal factor of constipation (Bouchoucha *et al.*, 2015). Another investigation indicated that constipation and obesity have common risk factors. However, little is known about constipation among individuals with severe obesity and the associated factors (Delgado-Aros *et al.*, 2004; Silveira *et al.*, 2021).

A recent study showed that obese individuals have several other risk factors for constipation such as physical inactivity, low quality of diet, and low consumption of fibers and vegetables in general (Chu *et al.*, 2014).

The present study aimed to examine the effect of water consumption, fiber intake, and PA on constipation, and which one is more critical by considering the mediating effect of BMI (Figure 1).



consumption, fiber intake, and PA on Constipation and by considering mediating effect of BMI

2 Subjects and Methods

This cross-sectional study involved 400 older adults in 2019, referring to the comprehensive health service centers in Karaj, the capital of Alborz province, located in the west of Tehran province (capital of Iran). The subjects were selected using the multi-stage sampling method. Thus, in the first stage, the city of Karaj was divided into four parts based on the socio-economic status of the city (good socio-economic status, moderate upward socio-economic status, medium-down socio-economic status, and low socio-economic status). Then, two health centers were selected from each part and subjects were selected by convenience sampling method.

The sample size was calculated by considering the 18% prevalence of constipation (Agachan *et al.*, 1996), 95% confidence interval, and 4% precision (d) using formula (1):

$$n = \frac{Z^2_{(1-\alpha/2)}\, P(1-P)}{d^2} \quad \ldots\ldots\ldots (1)$$

The inclusion criteria were age above 60 years, willing to participate in the study (filling conscious and voluntary consent form). At last, 400 elderly individuals were studied owing to the water consumption, fiber intake, physical activity, and constipation.

2.1 Data collection tools

Several instruments were employed to collect the data and their reliability was assessed among a sub-sample of 20 older individuals using Cronbach's alpha coefficient.

The demographic and anthropometric characteristics questionnaire included the variables of age, sex, education, income, marital status, gastrointestinal diseases (having or not), and Body Mass index (BMI).

The same calibrated digital scales were used for weighing and standing tape was used to measure height while the study subjects were standing and not wearing shoes with the normal shoulders position. BMI was calculated by dividing weight / (heigh)^2, and income status was measured by asking their monthly income (due to Iranian currency). Based on the society context, the individuals were divided into low, medium, and high economic status.

Constipation assessment tool was employed to assess constipation by the Wexner score (Mirbehresi *et al.*, 2020) with eight items, scored based on five-point Likert scale except for one item, scored 0 – 2. The details of the instrument scoring are described in the previously published article, assessed the psychometric properties of the Wexner questionnaire among Iranian population (Lee *et al.*, 2014).

Total fluid consumption glasses were used to assess total fluid intake of the participants by determining the average number of water glasses (including plain water intake, water from beverage) they usually consume per day and their usual intra-meal fluid intake (Majidirad *et al.*, 2021). Standard containers were provided as visual aids to help participants recall water intake accurately. The internal consistency of the questionnaire was obtained 0.79 using Cronbach's alpha coefficient.

The dietary fiber intake was assessed using the following methods:

a) Food Frequency Questionnaire: Dietary fiber intakes of participants were examined using a validated 106-item semi-quantitative food frequency questionnaire, as described elsewhere in detail (Mirbehresi *et al.*, 2020). The FFQ was administered in combination with a photo album of foods for more reliable data. The daily intake of fibers for each participant were estimated based on the US Department of Agriculture food-composition database, modified for Iranian foods.
b) A 24-hour recall: Subjects were asked to estimate their daily intake of fiber (whole grains, fruit and vegetable, and legumin) at breakfast, lunch, dinner, and between meals as snacks or desserts following a nutrition guideline card.

Physical Activity (PA): The modified version of PASE was used to measure self-reported PA. It is a brief and easily scored questionnaire designed specifically to assess PA over a week in the epidemiologic studies of the elderly (Keshteli *et al.*, 2014). The questionnaire contains three sections regarding the frequency and duration of leisure-time activities, household activities, and work-related activities, which has been translated and validated in Iran (Eshaghi *et al.*, 2010). The overall PASE score ranges from 0 – 400 or more (Keshteli *et al.*, 2014).

Persian lifestyle questionnaire included 46 items and 5 domains (Prevention [15 items], exercise [5 items], healthy diet [14 items], stress management [5 items], and social relationships [7 items]. This questionnaire was developed by

Eshaghi *et al.* (2010). In each question, the option that represents the most unfavorable level of the lifestyle is attributed a score of zero, and the other options are given scores of 25, 50, 75, and 100 in order of increasing desirability of the lifestyle level. After summarizing the scores of the questions in the questionnaire, scores of 76 to 100 indicate a desirable lifestyle, 51 to 75 an average lifestyle, and less than 50 an undesirable lifestyle Movahedi *et al.*, (2016) assessed validity and reliability of the questionnaire.

2.2 Ethical consideration

This research has been approved by the Ethics Committee of Alborz University of Medical Sciences, (Ethical code no. IR.ABZUMS.REC. 1402.218).

2.3 Data analysis

The descriptive data were analyzed using SPSS 26 software and the path analysis -related data were analyzed using LISREL software version 8. First, the normality of the data was assessed by using Kolmogorov–Smirnov test ($p > 0.05$).

The correlations between variables were calculated for path analysis. Some factors such as fluid intake, fiber consumption, physical activity was regarded as predictor variables, BMI as mediating variables, and constipation as dependent variable. Chi-square indices to the degree of freedom X2 / df, root error index of mean RMSEA squares, NFI normalized fit index, non-softened fit index NNFI, CFI adaptation fit index, GFI goodness-fit index AGFI modified were used to fit the model.

3 Results

The mean age of participants was 67 and the largest sample size (236) was between 66 – 70 years old, and about 52.75% of the participants were employed. Most of the subjects (42%) had diplomas and nearly 50.75% had the middle-income status.

There is no difference in the demographic characteristics between constipated and non-constipated patients ($p > 0.05$) (Table 1).

Table 1. Characteristics of study sample (n = 400)

Variables	Total	Constipated Patients (n=238)	Non- constipated patients (n =162)	*p*-value*
Age (n (%)				
60-65	121 (30.25)	72(3.03)	49	0.867
66-70	236 (59)	142(59.66)	94	
>70	43 (10.75. 5)	24(10.08)	19	
Mean± SD	66.54 ± 3.58	66.63 ± 3.41	66.41 ± 3.82	0.545
Sex				
Male	207 (51.75)	119(50)	88(54.32)	0.396
Female	193 (48.25)	119(50)	74(45.68)	
Education				
<12	157(43.75)	92(38.66)	65(40.12)	0.361
12	168(42)	96(40.34)	72(44.44)	
12>	75 (18.8)	50(21.01)	25(15.43)	
Marital status				
Married	218 (54.5)	126(52.94)	92(56.79)	0.448
Widowed/divorce	182 (45.5)	112(47.06)	70(43.21)	
Income				
Low	126(31.5)	72(30.25)	54(33.33)	0.569
Intermediate	203(50.75)	120(5.42)	83(51.23)	
High	71(17.75)	46(19.33)	25(15.43)	
Employment status				
Employed	211(52.75)	117(49.16)	94(58.02)	0.127
Retired	127(31.75)	78(32.77)	49(30.25)	
Housewife	62(15.5)	43(18.07)	19(11.73)	
Smoking				
Yes	152(38)	86(2.05)	66(40.74)	0.351
No	248(62)	152(63.87)	96(59.26)	
Gastrointestinal disease				
Yes	84(21)	70(29.41)	14(8.64)	< 0.001
No	316(79)	168(70.59)	148(91.36)	

Table 1. Continued

Variables	Total	Constipated Patients (n=238)	Non- constipated patients (n =162)	*p*-value*
BMI				
<25	162(40.5)	94(39.5)	68(41.98)	0.713
26-30	169(42.25)	100(42.01)	69(42.59)	
>39	69(17.25)	44(18.49)	25(15.43)	

Note. * $p < 0.05$

The mean of fiber intake, fluid consumption, and physical activity were 8.60, 4.65 ± 1.63, and 126.83 ± 88.39, respectively. The mean and standard deviation of the variables were reported among constipated patients versus non-constipated patients (Table 2).

Model structure

Due to the final fitted model (Figure 2), only BMI directly affects constipation, and other variables were associated with constipation both directly and indirectly. Physical activity

Table 2. Comparison fiber intake, fluid consumption and physical activity between constipated and non – constipated patients

Groups	Constipated Patients (n=238)	Non- constipated patients (n =162)	*p-value*
Fiber Intake (g/day)	7.54 ± 3.17	10.16 ± 3.49	< 0.001
Fluid consumption (Glass)	4.31 ± 1.70	5.15 ± 1.37	< 0.001
Physical activity (day)	107.07 ± 82.36	155.86 ± 7.01	< 0.001
Prevention	46.990 ± 15.35	14.57 ± 14.56	0.007
Stress Management	37.22 ± 14.84	41.12 ± 14.61	0.008
Social relationship	67.19 ± 14.89	71.26 ± 14.76	0.006

There is a significant negative correlation between fiber consumption, fluid intake, physical activity and constipation (Table 3). Before testing the model, the correlation between constipation and fiber consumption, fiber intake, and body mass index was evaluated.

Table 3. Correlation between fiber, fluid, PASE, BMI and constipation

Variables	fiber	fluid	PASE	BMI	Constipation
Fiber	1				
Fluid	.307**	1			
PASE	.253**	.169**	1		
BMI	-.298**	-.242**	-.156**	1	
Constipation	-.373**	-.292**	-.314**	.251**	1

Note. ** Correlation is significant at the 0.01 level (2-tailed).

(β=1) is the most influential variable on constipation and fiber consumption is the second important factor regarding constipation (Table 4).

Table 5 indicates the final path model fitted well (CFI =1, RMSEA = 0.00, GFI = 1) and the Goodness of fit indices for the model.

Table 4. Path Coefficients for study predictors on constipation among elderly

Variables	Direct effect	Indirect effect	Total effect	R^2
BMI	0.33	----	0.33	0.99
Physical Activity	0.67	0.33	1	
Fiber intake	0.03	0.013	0.043	
Fluid consumption	0.01	0.003	0.013	

Table 5. Goodness of fit Indices for the model

Fitting index	X2	df	RMSEA	GFI	NFI	CFI	NNFI
Model Index	5.55	5	0.0	1	1	1	0.99
Acceptable Range	X2/df < 5		< 0.05	> 0.90	> 0.90	> 0.90	> 0.90

Note. IFI: Incremental fit indices, NFI: Normed-fit index, GFI: Goodness-of-fit statistic, RMSEA: Root mean square error of approximationX^2: chi-square

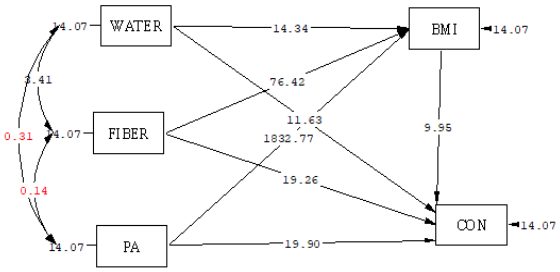


Figure 2. Path route effect of Water consumption, fiber intake, and PA on Constipation and by considering mediating effect of BMI

4 Discussion

Based on the final fitted model, PA is the most critical factor related to constipation compared to fluid intake and fiber consumption. The finding of the present study was in line with the results of the several studies (Keshteli *et al.*, 2014; Movahedi *et al.*, 2016). An interventional study conducted on 125 obese premenopausal women with chronic constipation showed that 12 weeks of PA positively affects constipation (Washburn *et al.*, 1993).

Furthermore, physical activities such as jumping, standing position, gravity, and belly muscle contraction lead to the incitement of the gut transmit and push stools to the rectum, and increasing stimulation and augmentation of energy expenditure during physical activity was found to influence energy intake, which needs to increase dietary fiber intake (Huang *et al.*, 2014; Nour-Eldein *et al.*, 2014; Keikavoosi-Arani & Salehi, 2019).

Based on the final fitted model, fiber consumption is the second most effective factor in constipation and there is a negative association between constipation and fiber intake. Increased dietary fiber intake can result in diminishing colonic transit time and increasing stool mass (El-Salhy *et al.*, 2014; Fosnes *et al.*, 2011).

Studies revealed that a high-fiber diet can enhance stool weight, resulting in decreasing colon passage time, while a low-fiber diet leads to the constipation (Paw *et al.*, 2006; El-Salhy *et al.*, 2014). It is recommended to consume soluble fiber (e.g., psyllium), which contains better results than insoluble fiber (e.g., bran) (El-Salhy *et al.*, 2014), and fiber should be increased gradually to avoid the side effects (Yang *et al.*, 2012).

Based on recent study results, "increasing DF intake was associated with stool consistency-related constipation among physically active participants, but not among non-active participants. However, increasing DF intake was not significantly associated with stool frequency in different physical activity groups" (Pare, 2011).

Fluid intake alongside the PA and fiber consumption affect constipation in the present study. High fiber food and proper fluid intake are essential factors in general health and the non-medical treatment of constipation and obesity (U.S. Department of Health and Human Services [HHS] & U.S. Department of Agriculture [USDA], 2010).

The present study evaluated the constipation based on both stool consistency and stool frequency and failed to assess the impact of physical activity on stool consistency and stool frequency separately.

Furthermore, based on the present current study results, PA affects constipation through BMI. Another study indicated that PA and weight reduction improve constipation among middle-aged premenopausal women with constipation in the short term (Li *et al.*, 2021).

Despite the association between obesity and constipation, obesity is not distinguished as a causal element of constipation. In the same vein, a study indicated that obese people have several other risk factors for constipation, for example, obese individuals are less physically active with lower fiber intake and poorer quality diets (Stewart *et al.*, 2010).

The present study assessed the effect of several factors such as age (Tantawy *et al.*, 2017), sex (Alsheridah *et al.*, 2018), education (Spinzi *et al.*, 2009), smoking (Verkuijl *et al.*, 2020), marital status (Lee *et al.*, 2014), occupation (Du *et al.*, 2022), and income (Werth & Christopher, 2021) between constipated and non-constipated individuals, and two groups were homogeneous in this regard.

Limitations

Given that the present study was conducted among older adults in the urban area of Karaj, the results should be generalized to other communities with caution. In addition, constipation in the present study was assessed using the subjective assessment and applying objective assessment (Like

defecography) is recommended in the future studies. Finally, the recall bias should be considered, since the data were collected through self-report questionnaires.

5 Conclusion

The results revealed the strong effect of physical activity on constipation, which is better considered in the interventional studies. Since price is considered one of the barriers to fiber consumption among the elderly, the recommendation to engage in physical activity such as walking to solve the issues of constipation is an effective and inexpensive alternative and advice for people with different socioeconomic status.

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Conflicts of Interest: The Authors declare that there is not any conflict of interest.

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