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Functional Constipation in Elderly and Related Determinant Risk Factors: Malnutrition and Dietary Intake

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ABSTRACT

Aim: The objective of this study was to evaluate the relationship between FC and physical activity, dietary intake and malnutrition in the elderly.

Method: A cross-sectional study was conducted on 883 adults aged >65 years from nursing homes and community health centers in Turkey. Constipation status was evaluated according to Rome IV criteria and Bristol Stool Form Scale. Dietary intake was assessed using a food consumption record (24-hour food recall). The dietary energy and nutrients were analyzed using the "Nutrition Information Systems Package Program". The nutritional status of participants was evaluated using the Mini-Nutritional Assessment (MNA) test. The International Physical Activity Questionnaire (IPAQ, short form) was used to assess physical activity status.

Results: Among the 883 participants, 29.6% were classified into the FC group (32.2% of females, 25.8% of males). The FC group had significantly lower total energy, fluid, water, protein, carbohydrate, magnesium, zinc, phosphorus, potassium, soluble fiber, insoluble fiber, total fiber, and fiber (g)/1000 kcal intake than the non-FC group ($p < 0.05$). The multivariate logistic regression analysis showed that total dietary fiber intake was significantly associated with a lower prevalence of FC (OR: 0.98, 95% CI: 0.96–0.99). According to MNA, participants at risk of malnutrition (OR: 5.21, 95% CI: 3.09–9.77) and malnourished participants (OR: 3.03, 95% CI: 1.62–5.68) had a greater likelihood of FC compared with normal participants. Participants in the middle lower quartile of water intake (OR: 0.63, 95% CI: 0.42–0.95) had a decreased likelihood of FC compared with participants in the lowest quartile.

Conclusion: FC is a common gastrointestinal disorder among the elderly in Turkey. Low dietary fiber intake, low water intake and malnutrition were important risk factors associated with FC in the elderly.

Abbreviations: BMI: body mass index; FC: functional constipation; IPAQ-SF: International Physical Activity Questionnaire-Short Form; MNA: Mini-Nutritional Assessment; WHO: World Health Organization

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Functional constipation; malnutrition; water intake; fiber intake

Introduction

Aging is the sum of structural, functional and psychological changes that occur with a genetic program and with the effect of environmental factors in the organism (1). Advances in medicine and the awareness of protecting and maintaining health have provided the expected life expectancy and increased the number of individuals aged over 65 years (2). With this increase in the elderly population, health problems seen in old age have gained importance. One of the health problems frequently encountered in old age is constipation (3). Constipation is defined as a bowel disease that can result in infrequent stools and difficult stool passage, along with pain and stiffness (4).

Constipation is an important problem that can result in lethal bowel obstruction when clinical symptoms are overlooked (5). Constipation without organic etiology is defined as functional constipation (FC) and is diagnosed according to the the Rome criteria (6). Recently, the Rome IV criteria have been commonly implemented for the diagnosis of FC (6). However, there are few studies on the prevalence of FC in the general population based on the Rome IV diagnostic criteria (7–9).

It has been shown that FC is more common in the elderly and may have a negative affect on quality of life due to the need for repeated treatments (10, 11). Many factors, such as gender, inadequate dietary fiber and water intake, lower physical activity, stress, depression, hemorrhoids, and some drugs (analgesics, antidepressants etc.), are involved in the development of FC in the elderly (12, 13). In one study, it was observed that there was a relationship between nutritional status and constipation status. Both malnutrition and

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constipation may lead to fatal consequences in the elderly (3, 14), and therefore, evaluating the constipation status in the elderly and knowing the associated risk factors are important for preventing or minimizing constipation. However, there are limited data evaluating FC according to the Rome IV criteria and the associated risk factors in the elderly. In this context, this study was planned to assess the prevalence of FC and to evaluate the relationship between FC and physical activity, dietary intake and malnutrition in the elderly.

Materials and methods

Subjects and survey procedure

This cross-sectional study was conducted in nursing homes and community health centers with adults aged >65 years in Turkey. The flow chart of the study is shown in Figure 1. Volunteer participants were recruited to the study. They were informed about the study and signed a consent participation form that adhered to the Declaration of Helsinki protocols (World Medical Association). Questionnaires were collected from 984 participants using the face-to-face interview technique; however, 8 had irritable bowel syndrome, 65 were using products and medications to improve bowel movements, 11 were younger than 65 years, 2 were of unknown age and 15 provided insufficient information so were excluded from further analysis. The questionnaire form was composed of questions to determine the demographic characteristics, health information, nutritional habits, frequency of fluid and food consumption and the status of constipation. Ethical approval was obtained from the Gazi University Ethics Committee.

Evaluation of constipation status

Constipation status was evaluated according to Rome IV criteria (Supplementary Table 1). Rome IV criteria were developed in 2016 and validated in adults by Palsson et al. (15). Participants with two or more positive items were classified into the FC group and the remaining participants were classified into the nonfunctional constipation group (non-FC).

The Bristol Stool Form Scale was used to assess stool consistency on a spectrum of seven types: Types I and II denote hard or lumpy stools and Types VI and VII denote loose or watery stools with rapid transition (16, 17). One of the Rome IV criteria, "lumpy or hard stools with >25% defecation", was evaluated according to the Bristol Stool Form Scale and participants who indicated Types I and II were deemed to meet this criterion.

Assessment of dietary intake

Dietary intake was assessed using a food consumption record (24-hour food recall). How to fill in the food consumption record was explained to the patient and/or their relatives. A "Meal and Food Photo Catalog" was used to determine the sizes and amounts of the food and beverages consumed (18). The contents of the meals consumed by participants were calculated using a "Standard Recipes" book (19). The

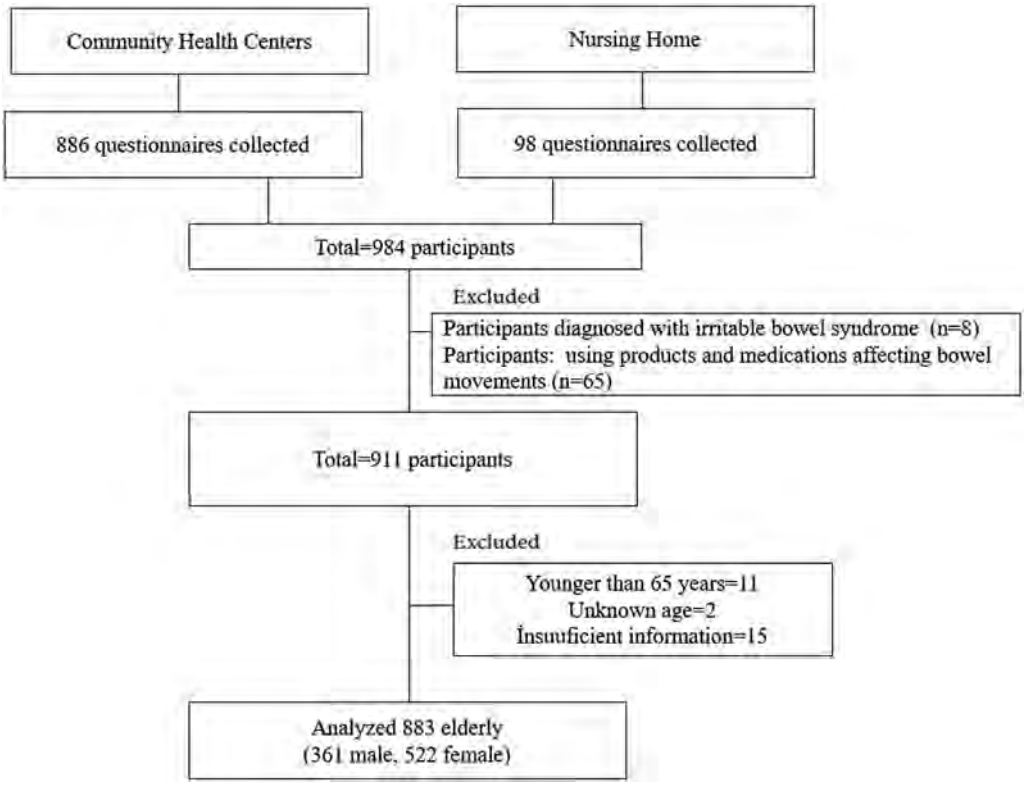

Figure 1. Flow chart of the study.

Table 1. Characteristics of participants.

Characteristics		n (%) or mean ± SD			
		FC (n = 261)	Non FC (n = 622)	Total (n = 883)	p value
Age (years)	72.5 ± 7.24	71.5 ± 6.07	71.8 ± 6.45	71.8 ± 6.45	**0.044**
Gender	Male	93 (35.6%)	268 (43.1%)	361(40.9%)	**0.043**
	Female	168 (64.4%)	354 (56.9%)	522 (59.1%)	
Region	Urban	358 (57.6%)	156 (59.8%)	514 (58.2%)	0.543
	Rural	264 (42.4%)	105 (40.2%)	369 (41.8%)	
Marital Status	Single	5 (1.9%)	16 (2.6%)	21 (2.4%)	
	Married	158 (60.5%)	424 (68.2%)	582 (65.9%)	0.059
	Divorced	4 (1.5%)	14 (2.3%)	18 (2.0%)	
	Widow	94 (36%)	168 (27%)	262 (29.7%)	
Educational level	Illeterate	27 (10.3%)	92 (14.8%)	119 (13.5%)	
	Literate	51 (19.5%)	83 (13.3%)	134 (15.2%)	0.082
	Primary school	114 (43.7%)	290 (46.6%)	404 (45.8%)	
	Secondary school	25 (9.6%)	47 (7.6%)	72 (8.2 %)	
	High school	33 (12.6%)	73 (11.7%)	106 (12.0%)	
	University	11 (4.2%)	27 (5.9%)	48 (5.4%)	
Comorbidity	Cardiovascular disease	116 (44.4%)	235 (37.8%)	351 (39.8%)	
	GI disesase	61 (23.4 %)	69 (11.1%)	130 (14.7%)	
	Respiratory disease	42 (16.1%)	63 (10.1%)	105 (11.9%)	
	Endocrine	15 (5.7%)	31 (5.0%)	46 (5.2%)	
	Neurologic	18 (6.9%)	15 (2.4%)	33 (3.7%)	
Smoking	Yes	24 (9.2%)	65 (10.5%)	89 (10.1%)	0.651
	No	237 (90.8%)	537 (40.5%)	679 (76.9%)	
Alcohol use	Yes	3 (1.1%)	22 (3.5%)	25 (2.8%)	0.070
	No	258 (98.9%)	600 (96.5%)	828 (93.8%)	
Physical activity	Inactive	226 (86.6%)	501 (80.5%)	727 (82.3%)	0.085
	Moderately active	69 (11.1%)	91(10.3%)	22 (8.4%)	
	Active	13 (5.0 %)	52 (8.4%)	65 (7.4 %)	
MNA score	12	130 (49.8%)	429 (69.0%)	559 (63.3%)	**<0.001**
	11–7 (at risk of malnutrition)	96 (36.8%)	172 (27.7%)	268 (30.4%)	
	≤7 (malnourished)	35 (13.4%)	21 (3.4%)	56 (6.3%)	
Water intake (mL)	Lowest q.(<1000 mL)	247 (39.7%)	145 (55.6%)	392 (44.4%)	
	Middle lower q.(1000-1200 mL)	45 (7.2%)	16 (6.1%)	61 (6.9%)	**<0.001**
	Middle upper q.(1200-2000 mL)	278 (44.7 %)	84 (32.2%)	362 (41.0%)	
	Highest q. (>2000 mL)	52 (8.4 %)	16 (6.1%)	68 (7.7%)	

p was calculated by chi-square test. Significant values are shown in bold ($p < 0.05$).
MNA: mini nutritional assessment, FC: functional constipation.

dietary energy and nutrients were analyzed using the "Nutrition Information Systems Package Program (BeBiS, Ebispro for Windows, Germany; Turkish Version/BeBiS 8) (20). Water intake was assessed by quartiles.

Anthropometric measurements

The body weights of the participants were measured using a Medical Scale DR-Mod 85 electronic scale. Height (cm) was measured with feet close together and the head in the Frankfort plane using a portable stadiometer with 0.1 cm accuracy. Body mass index (BMI) was calculated by dividing body weight (kg) by the height squared (21).

Physical activity

The International Physical Activity Questionnaire (IPAQ, short form) was used to assess physical activity status. The short form consists of seven questions and provides information about the time spent walking and the time spent on moderate–severe and severe activities. Participants were grouped as "inactive", "moderately active" and "active", according to their physical activity status (22).

Nutritional status

The nutritional status of participants was evaluated using the Mini-Nutritional Assessment (MNA) test. A maximum score of 14 is obtained from the test: > 12 points is accepted as normal, ≤ 11 as malnutrition risk and ≤ 7 as malnourished (23).

Statistical analyses

Statistical analyses were conducted using SPSS for Windows (Statistical Package for Social Sciences, version 23.0, Chicago, IL, USA). Chi-square and *t*-tests were used to analyze the differences in patient characteristics and outcomes. Multivariable logistic regression analyses were utilized to identify risk factors for FC while controlling potential confounders. The odds ratio (OR) and 95% confidence interval (CI) were estimated for each factor. A p value of <0.05 was considered to be statistically significant.

Results

In total, 883 participants were analyzed in the study: 361 (40.9%) were male and 522 (59.1%) were female. The mean age of participants was 71.8 ± 6.45 years. Among the 883

Table 2. Comparison of dietary intake of the participants with and without FC.

	FC (n = 261)	Non FC (n = 622)	p value
Total energy (kcal/day)	1573.1 ± 509.13	1684.8 ± 528.22	**0.004**
Total fluid (mL)	1993.69 ± 1040.83	2236.53 ± 1022.62	**0.001**
Total water (mL)	1184.46 ± 624.1	1391.0 ± 671.17	**<0.001**
Total water (g) (from meal)	976.97 ± 649.48	959.0 ± 509.82	0.662
Protein (g)	60.9 ± 24.66	67.5 ± 25.79	**0.005**
Protein intake (% of energy)	15.9 ± 3.96	16.28 ± 4.02	0.247
Fat (g)	60.9 ± 24.6	66.1 ± 25.02	0.828
Fat intake (% of energy)	35.6 ± 8.17	34.6 ± 7.63	0.082
Carbohydrate (g)	183.1 ± 65.11	201.1 ± 73.45	**0.001**
Carbohydrate (% energy/day)	48.3 ± 9.74	48.8 ± 9.03	0.437
Calcium (mg)	761.1 ± 388.62	819.5 ± 430.71	0.049
Magnesium (mg)	250.8 ± 129.28	292.6 ± 346.94	**0.009**
Zinc (mg)	8.5 ± 3.81	9.1 ± 3.94	**0.036**
Phosphorus (mg)	1006.5 ± 371.82	1111.6 ± 439.35	**0.029**
Potassium (mg)	2191.4 ± 825.37	2400 ± 825.37	**0.020**
Solubl fiber (g)	6.7 ± 4.38	8.06 ± 4.71	**<0.001**
Insolubl fiber (g)	12.9 ± 7.67	15.3 ± 10.33	**<0.001**
Total fiber (g)	20.6 ± 11.55	24.1 ± 14.65	**<0.001**
Total fiber g/1000 kcal	13.1 ± 5.22	14.3 ± 6.24	**0.004**

Significant values are shown in bold ($p < 0.05$).
FC: Functional constipation.

participants, 29.6% were classified into the FC group (32.2% of females, 25.8% of males).

The characteristics of participants according to constipation status are shown in Table 1. Statistically significant differences between the FC and non-FC groups were found for age, gender and MNA score ($p < 0.05$) but no significant differences were obtained for region, educational level, BMI, comorbidity, smoking, alcohol use or physical activity level. Among the participants, 30.4% were at risk of malnutrition and 6.3% were malnourished. In addition, there was a significant difference between the nutritional status and the constipation status of the elderly.

Table 2 shows the dietary intake of participants according to constipation status. The FC group had significantly lower total energy (kcal/day), fluid (mL), water (mL), protein (g), carbohydrate (g), magnesium (mg), zinc (mg), phosphorus (mg), potassium (mg), soluble fiber (g), insoluble fiber (g), total fiber (g), and fiber (g)/1000 kcal intake than the non-FC group ($p < 0.05$) (Table 2). No significant differences were found in the protein intake (% of energy), fat (g), fat intake (% of energy), and carbohydrate (% energy/day) between the two groups ($p > 0.05$).

Multivariate logistic regression analysis (Table 3) showed that total dietary fiber intake was significantly associated with a lower prevalence of FC (OR:0.98, 95% Cl: 0.96–0.99).

According to the MNA, participants at risk of malnutrition (OR: 5.21, 95% Cl: 3.09–9.77) and malnourished participants (OR: 3.03, 95% Cl: 1.62–5.68) had a greater likelihood of FC compared with normal participants ($p < 0.05$) (Table 3).

Participants in the middle lower quartile of water intake (OR: 0.63, 95% CI: 0.42–0.95) had a decreased likelihood of FC compared with participants in the lowest quartile of water intake ($p < 0.05$).

Discussion

Constipation is a common health problem in the elderly and its prevalence is between 9% and 60% according to the diagnostic criteria adopted (12, 24). Application of the Rome IV criteria provided a more uniform description of FC and a better understanding of its prevalence (25). In the present study, prevalence of FC was found to be 29.6%. However, in a study conducted with 160 elderly (mean age: 78 ± 8.1 years) at a nursing home in Turkey by Okuyan et al. (26), the prevalence of FC was found to be 51.9% (26). The low prevalence in the present study compared to that of Okuyan et al. may be explained by the inclusion of participants in community health centers as well as nursing homes and also the lower average age of the participants. It has been reported that constipation is more common in the elderly in nursing homes (26). Howard et al. (27) stated that approximately 50-73% of the elderly living in nursing homes are affected by constipation (27). In addition, it has been shown that the prevalence of constipation in the elderly increases with age (12). In a study in which the elderly over 60 years of age were included in Egypt, the prevalence of FC was found to be 24.8% according to the Rome III criteria (28). In this context, the higher prevalence of FC in our study compared to the aforementioned study may be associated with the inclusion of the elderly over 65 years of age. Dore et al.(14), in a study conducted with 1351 elderly people in Italy, found that constipation prevalence was 31.2% according to the self-report method. In our study, the reason for the prevalence differing from Dore et al. and other studies can be attributed also to the sample size and the different diagnostic criteria used.

It is well known that constipation is more frequent in females and that its prevalence increases with age (29). In the present study participants with FC were older than non-FC participants and the prevalence of FC was higher in females compared to males. These findings are consistent with previous studies conducted with the elderly (30, 31). However, age and gender were not associated with constipation (Table 3). Moreover, a high BMI was not confirmed as a potential risk factor. These results could be attributed to the low number of participants with a high BMI and the sample size (14).

Table 3. Multivariate logistic regression of risk factors associated with FC.

Variables		B	OR	95% CI	p value
Age (years)		0.09	1.00	0.98-1.03	0.483
Gender	Male*	–			
	Female	0.17	0.84	0.60-1.17	0.314
BMI (kg/m^2)		0.02	1.02	0.99-1.05	0.165
IPAQ	Inactive*	–			
	Moderately active	−0.25	0.77	0.45-1.32	0.357
	Active	−0.45	0.63	0.33-1.22	0.178
MNA score	12*	–			
	11-7(atriskof malnutrition)	0.57	1.78	1.27-2.48	**0.001**
	≤7(malnourished)	1.62	5.09	2.78-9.35	**<0.001**
Water intake (mL)	Lowest quartile	–			
	Middle lower quartile	−0.33	0.71	0.37-1.35	0.303
	Middle upper quartile	−0.44	0.63	0.42-0.95	**0.029**
	Highest quartile	−0.46	0.62	0.28-1.36	0.239
Total fluid (mL)		0.00	1.00	1.00-1.00	0.877
Energy (kcal/day)		0.00	1.00	0.99-1.00	0.135
Total fiber (g)		−0.02	0.98	0.96-0.99	**0.007**
Magnesium (mg)		0.00	1.00	0.99-1.00	0.556
Zinc intake (mg)		0.01	1.01	0.96-1.07	0.534

*Reference group, Significant values are shown in bold ($p < 0.05$).
FC: functional contipation; BMI: body mass index; MNA: Mini-NutritionalAssessment; IPAQ: International Physical Activity Questionnaire CI: confidence interval; OR: odds ratio..

A low physical activity level has been identified as a risk factor for constipation in children and adults (32, 33). Similarly, Vargas-García et al. (34) found that lower physical activity levels are associated with constipation in the elderly. In another study, it was determined that elderly people who do not do regular physical activity have more constipation problems (26). In contrast, in the present study no relation was found between physical activity level and constipation (Table 1). Towers et al. (35) obtained findings consistent with these results in their study in the elderly. Another study showed that physical inactivity did not independently correlate with passing fewer than three stools per week or hard/lumpy stools in adult Americans (36). Failure to achieve consistent results in studies evaluating physical activity and constipation can be explained by the fact that the scales evaluating constipation status and physical activity level are diverse and thus different results are obtained. Moreover, conflicting results can be attributed also to the study population. In the present study, most of the participants (82.3%) were inactive according to the IPAQ. Thus, active subjects were inadequately represented in this study. Physical activity is likely to have an impact on preventing constipation or reducing its severity, but its mechanism of action has yet to be established (37). It is suggested that exercise affects colonic motility and accelerates intestinal transit (37).

It has been suggested that malnutrition may be the determinant of constipation (14). In the present study, multivariate analysis showed that participants at risk of malnutrition and malnourished participants had a greater risk of FC compared with normal participants (Table 3). In agreement with this study, Farahat et al. (28) reported a significant relation between constipation and malnutrition in the elderly. Similarly, Dore et al. (14) found that the risk of constipation is significantly higher in patients at risk of malnutrition. In another study, it was observed that there was a relationship between nutritional status and constipation status, with an increase in constipation status as the nutritional status deteriorated (3). In line with these results it has been stated that, with aging, subjects experience inadequate and imbalanced nutrition problems and accordingly the risk of malnutrition increases (3). Yang et al. (38) demonstrated that a relatively low energy intake was associated with increased constipation risk in women. Moreover, low food intake due to anorexia has been shown to be a possible aggravating factor for constipation in older adults (39). Taken together, in this study, subjects at risk of malnutrition may have lower food intake and thus lower energy and fiber intake, which may be associated with constipation. Slowing of intestinal peristalsis, pelvic floor dysfunction and anorectal abnormalities with aging have been reported to cause an increase in the incidence of FC and malnutrition in the elderly (39). Accordingly, it has been reported that anorexia and FC may interact closely and result in a vicious circle (39).

It is known that a lower than recommended dietary fiber intake is associated with FC. (40). The recommended dietary fiber intake is 14 g per 1000 kcal in adults (41). In the present study, dietary fiber intake was 13.1 g per 1000 kcal in the FC group and 14.3 g in the non-FC group (Table 2). Participants with FC failed to meet the daily total fiber recommendations. Regression analysis showed that a low total dietary fiber intake was associated with greater risk of constipation (Table 3). The FC group had significantly lower soluble and insoluble fiber intakes than the non-FC group ($p < 0.05$) (Table 2). The possible mechanism of action of soluble and insoluble dietary fiber on constipation can be explained as follows. Soluble fiber reduces the pressure in the intestinal lumen, expands the intestinal diameter and increases bowel movement. It draws water to form a gel consistency, thereby increasing the volume and softness of the stool and making it easier to pass through the lumen (42). Insoluble fiber helps to soften and expand waste in the intestines by keeping the water in it, thus allowing substances to pass into the digestive system more quickly and easily. In this way, insoluble fiber prevents constipation and its associated ailments (42).

It is suggested that the elderly form regular and initiative drinking habits before thirst, drinking 1500–1700 mL of water daily (43). Adequate hydration is thought to be important for maintaining intestinal motility (44). In the present study, the FC group had a significantly lower water intake (1184.46 ± 624.10 mL) than the non-FC group (1391.0 ± 671.17 mL) ($p < 0.05$) (Table 3). Participants in the middle lower quartile of water intake had a decreased likelihood of FC compared with participants in the lowest quartile of water intake (Table 3). Some studies reported that low water intake might be an etiological factor for constipation in adults, but the potential beneficial effect of extra water intake is uncertain (45, 46). In univariate analysis, low fluid intake was significantly associated with an increased risk of FC, although this significant association disappeared in multivariate analysis (Table 3). This is consistent with a study in the elderly by Lindeman et al. (47), which showed that increased fluid intake does not help to prevent chronic constipation.

In the present study, the FC group had significantly lower magnesium and zinc intakes than the non-FC group ($p < 0.05$) (Table 2). However, multivariate logistic regression analysis suggested that these relationships might have resulted from confounding factors (Table 3). Similarly, Asakura et al. (32) found that magnesium and zinc were related to constipation but that the relationship disappeared after adjustment. It has been reported that magnesium may form sulfate or citrate salts, which will support fluid retention in the digestive tract and change motility, thereby acting as a mild laxative (45, 48). Further examination is required to understand the relationship between magnesium/zinc and constipation (45).

There is evidence that a low calorie intake may be a factor in the development of constipation because it increases the colonic transit time (49). This study showed that participants with FC consume fewer calories compared to participants without FC (Table 2). After controlling for confounding factors, no association was seen for energy intake (Table 3). Towers et al. (35) found that constipated participants had a lower energy intake compared to controls. These results were explained by the possibility that constipation can prevent gastric emptying and delay passage through the colon, which may lead to early satiety and reduced energy intake (35).

The strengths of our study are the use of the Rome IV and Bristol criteria to define constipation and also the 24-hour dietary recall to assess dietary intake. To our knowledge, this is the first study to evaluate between FC and physical activity, dietary intake and malnutrition in the elderly. A limitation of our study is its cross-sectional design. Therefore, a causal relationship between FC and its risk factors could not be determined. Hence, further population-based studies with larger sample sizes and long-term follow-up are required to identify the risk factors and potential interventions for FC.

Conclusion

The study results indicate that FC is a common gastrointestinal disorder among the elderly in Turkey, with a prevalence of 29.6%. Low dietary fiber intake, low water intake and malnutrition were important risk factors associated with FC in the elderly.

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Disclosure statement

No potential conflict of interest was reported by the author(s).

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