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ORIGINAL ARTICLE

Observational Study

Epidemiological study: Correlation between diet habits and constipation among elderly in Beijing region

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Author contributions: Zhang M designed the research; Yang XJ performed data and statistical analysis, designed survey questions regarding diet habit and wrote the paper; Zhu HM and Tang Z performed the research; Zhao DD, Li BY and Gabriel A performed data collection and input.

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Abstract

AIM

To investigate correlations between diet and prevalence of constipation among elderly people in Beijing.

METHODS

A total of 2776 (≥ 60 years) were selected in Beijing region for investigation. Data regarding constipation and diet habits was collected *via* hierarchical status, segmentation and random cluster sampling. Investigation included constipation-related demographic indicators and diet habits. Door-to-door questionnaires and surveys included daily staple food intakes, frequency of fish, egg, fruits and vegetables consumption. Constipation was defined according to the China Chronic Constipation Diagnosis and Treatment Guideline (2013), with the following constipation judgment indicators: decreased defecation frequency, dry and hard stool, and difficulty in defecation.

RESULTS

The prevalence of constipation among elderly people in Beijing region was 13%. There was a positive correlation between prevalence of constipation and age, but negative correlations between prevalence of constipation and staple food, fish and dietary fibres

(fruits and vegetables) intakes. These differences were all statistically significant.

CONCLUSION

The prevalence of elderly constipation in Beijing region is closely related to diet habits, and is significantly decreased by high staple foods intake, fish eating and high dietary fibres (fruits and vegetables) consumption.

Key words: Constipation; Elderly; Diet; Epidemiology; Prevalence; Factors

Core tip: Because of high prevalence of constipation among elderly people, older populations are more susceptible to constipation related side effects. Many studies have concluded the significance of certain foods and dietary modification in treating constipation prior to any medical interventions. Benefits of frequent fish, dietary fibres consumption and large staple food intakes in alleviating symptoms of constipation were demonstrated in this study. Dietary modification should be promoted and emphasized as first line treatment to postpone or avoid drug use.

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INTRODUCTION

Constipation is a common gastrointestinal disease affecting all age groups, elderly individuals suffer particularly more than younger individuals, among which females have higher prevalence than males[1,2]. High incidence of constipation in older populations not only accounts for change in organ functions with age, but diet habits play an essential role in prevention and treatment. Many studies have suggested that high dietary fiber intake can significantly reduce prevalence and alleviate symptoms of constipation[3-6]. Constipation in older populations should firstly be treated with dietary modifications prior to any medical intervention to minimize side effects of certain drugs. Thus, we conducted an epidemiological study regarding diet habits and prevalence of constipation among elderly people in Beijing to further confirm the significance of diet in treating and alleviating symptoms of constipation without any potential side effects. This research is one of key parts of the special project, which funded by the National Health and Family Planning Commission of the People's Republic of China. The project consists of two related programs: (1) the study on comprehensive geriatric health evaluation index system; and (2) Multidimensional longitudinal study of aging among the elderly in Beijing.

MATERIALS AND METHODS

Research subjects

According to 2015 Beijing sampling data of 5th population census in China, a stratified, segmented and randomized cluster sampling method was used to investigate 2776 elderly people ($\geqslant$ 60 years) in urban (Xuanwu) and rural (Huairou and Daxing) areas of Beijing. Door-to-door questionnaires were used and collected, among which completed questionnaires regarding eggs and fish, fruits and vegetables were 2774 and 2486 respectively. Subjects' characteristics were the following: 1213 males (43.7%), 1563 females (56.3%), 1264 rural elderly (45.5%) and 1512 urban elderly (54.5%). Classification with regards to age: 60-64 years (510, 18.4%), 65-69 (485, 17.5%), 70-74 (551, 19.8%), 75-80 (607, 21.9%), > 80 (623, 22.4%).

Research method

Investigation was performed by uniformly trained professionals via door-to-door questionnaires in 2015 between July to September. Survey questions covered constipation-related demographic indicators and diet habits including daily staple food intake, frequency of fish, egg, fruits and vegetables consumption. Constipation was defined according to the China Chronic Constipation Diagnosis and Treatment Guideline (2013), with the following constipation judgment indicators: decreased defecation frequency, dry and hard stool, and difficulty in defecation. All questionnaires were anonymous and verbal consent was obtained from all participants.

Statistical analysis

EpiData was used to input data and establish database, processed data was converted to SPSS document. The *t* test was performed to analyze data and data was expressed in mean ± SD; χ^2 test was performed, $P < 0.05$ was considered statistically significant.

RESULTS

Age, region and gender

Of 2776 subjects from both urban and rural areas of Beijing, prevalence of constipation increased with age. Of 510 elderly aged 60-65, 41 of which were constipated (prevalence 8.0%); 11.1% for 65 years old and above group; 11.3% for 70-75 group; 18.8% for 75-80 group; and 17.8% for > 80 group. The difference was statistically significant ($P < 0.001$, $\chi^2 = 41.338$). However, differences between females and males ($\chi^2 = 0.981$), urban and rural areas ($\chi^2 = 0.771$)

Table 1 Age, region (rural, urban) and gender in relation with constipation

Items	Cases	Prevalence	Constipation	χ^2
Gender				
Male	1213	158	13.0	0.981
Female	1563	224	14.3	
Region				
Urban	1512	216	14.3	0.771
Rural	1264	166	13.1	
Age[a]				
60-65	510	41	8.0	41.338
65-70	485	54	11.1	
70-75	551	62	11.3	
75-80	607	114	18.8	
> 80	623	111	17.8	
Total	2776			

[a]$P < 0.001$.

Table 2 Correlation between daily staple food intakes and constipation

Staple food Intake	Cases	Constipation	Prevalence[a]
≤ 150 g	351	41	11.7%
200-300 g	1368	129	9.4%
350-450 g	530	47	8.9%
≥ 500 g	237	10	4.2%
Total	2486	227	9.1%

$\chi^2 = 9.833$; [a]$P < 0.05$.

were not statistically significant ($P > 0.05$ for both) (Table 1).

Staple food

Of total 2486 subjects, 227 were constipated and total prevalence was 9.1%. Daily staple food intakes and prevalence of constipation indicated a negative correlation and the difference was statistically significant ($\chi^2 = 9.833$, $P < 0.05$). Prevalence of constipation was 11.7% for consumption of less than and equal to 150 g per day; 9.4% for consumption of 200-300 g per day; 8.9% for consumption of 350-450 g per day; 4.2% for consumption of greater than and equal to 500g per day (Table 2).

Fish and egg

Of total 2774 subjects, 2632 egg eaters had 359 cases of constipation (prevalence 13.6%); 142 subjects who did not consume eggs had 23 cases of constipation (prevalence 16.2%). The difference was not statistically significant with $P > 0.05$ ($\chi^2 = 0.742$). Of total 2774 subjects, 2257 fish eaters had 292 cases of constipation (prevalence 12.9%); 517 subjects who did not consume fish had 90 cases of constipation (prevalence 17.4%). The difference was statistically significant with $P < 0.01$($\chi^2 = 7.080$) (Table 3).

Fruits and vegetables

Of total 2486 subjects, 2431 frequent vegetables

Table 3 Correlation between fish, egg eating and constipation

Items	Cases	Constipation	Prevalence	χ^2
Egg eater	2632	359	13.6%	0.742
Rarely eat	142	23	16.2%	
Fish eater	2257	292	12.9%[b]	7.080
Rarely eat	517	90	17.4%[b]	
Total	2774			

[b]$P < 0.01$.

Table 4 Correlation between fruits and vegetables consumption and constipation

Items	Cases	Constipation	Prevalence[a]	χ^2
Vegetables				
Frequent	2431	218	9.0%	3.546
Rare	55	9	16.4%	
Fruits				
Frequent	1783	150	8.4%	3.921
Rare	703	77	11.0%	
Total	2486			

[a]$P < 0.05$.

consumers had 218 cases of constipation (prevalence 9.0%); 9 out of 55 rare vegetable consumers were constipated (prevalence 16.4%). The difference was statistically significant with $P < 0.05$ ($\chi^2 = 3.546$). Of total 2486 subjects, 1783 frequent fruits consumers had 150 cases of constipation (prevalence 8.4%); 77 out of 703 rare fruits consumers were constipated (prevalence 11.0%). The difference was statistically significant with $P < 0.05$ ($\chi^2 = 3.921$) (Table 4).

DISCUSSION

This study has investigated the prevalence of constipation among elderly people in both urban and rural areas of Beijing. Our results show that the differences between females and males, living in urban or rural areas are not statistically significant ($P > 0.05$ for both) (Table 1). However, many other studies have indicated that females in general suffer more from constipation than males in all age groups[1,2]. Age is one of the most important risk factors, our results ($P < 0.001$) are in accordance with other studies which have concluded the prevalence of constipation increased with age (Table 1)[1,2]. The proportion of constipated elderly people increases drastically from 70-year-old group (11.3%) to 75-year-old group (18.8%), so dietary and lifestyle modifications are highly recommended as first line treatment in these age groups prior to any medical interventions. Ageing is a naturally occurring process which implies changes in organ functions with age, previous studies have pointed out that constipated older adults could have normal or delayed colonic transit, caused most commonly by distal colonic or anorectal dysfunction[7-9]. This irreversible process can be partially compensated by establishing a healthy

intestinal microbiota. Spinzi *et al*[10] have suggested that the faecal flora changed markedly with age mostly by a fall in numbers of bifidobacteria. Nowadays, probiotics are commonly prescribed and widely available, probiotics not only promote the growth of bifidobacteria, but shorten bowl transit and soften stools most likely by increased short chain fatty acid concentration and decreased colonal pH[11]. Although the causal relation between intestinal microbiome and constipation remains undefined, remarkable outcomes have been proven by the use of probiotics in alleviating constipation symptoms, probiotics supplement and fermented dairy products are highly suggested to be incorporated into diet due to lacks of side effects and food and drug interactions.

Staple foods in China generally refer to rice and wheat products such as noodles and steamed buns. Our results indicate a clear negative correlation between amount of staple food consumed and prevalence of constipation among elderly populations (Table 2). By increasing staple food consumption from 150 g per day up to 500 g and more per day, the prevalence of constipation decreases from 11.7% to 4.2% ($P < 0.05$). A Japanese study has found out a clear dose-response relationship between increased intake of rice and a decreased prevalence of constipation among young female dietetic students[12]. Also, increased intakes of rice at breakfast, lunch, and dinner were all associated with a decreased prevalence of constipation[12]. The protective effect of rice on constipation has also been indicated in two previous studies conducted in Asian communities where rice is the main staple food[13,14]. Two possible explanations can be speculated. (1) Elderly people are generally eating less than younger adults, so their caloric intake is also lower than young people. Towers *et al*[15] have concluded that there was a strong negative correlation between total transit time and number of calories as measured by the daily food diary ($r = -0.58$, $P < 0.0001$) and the diet questionnaire ($r = -0.28$, $P = 0.05$). Thus, slow transit times are associated with low caloric intake which potentially leads to constipation; and (2) rice and wheat products are main source of vitamins and minerals in China, some of constituents in rice and/or combinations of these constituents might exert a preventive effect on constipation[8]. However, Western countries have different dieting habits where potato, bread and corns are considered staple foods. Protective effects of staple food indicated in our results cannot be directly applied to Western countries due to differences in eating habits, further investigation is required to confirm the beneficial effects of staple food in Western diets.

In this study, we have established a relationship between fish eating, egg eating and prevalence of constipation in older age groups. Although the prevalence of elderly who do not eat eggs is higher than egg-eaters, this result is not statistically significant ($P > 0.05$). However, a negative correlation between fish eating and prevalence of constipation is demonstrated by our results (Table 3); elderly people who do not eat fish have higher prevalence than those fish eaters ($P < 0.01$). One study conducted on infants regarding diet and constipation has suggested that the easily digested proteins in breast milk, primarily whey, resulted in soft stools; breast-fed infants tended to have more frequent stools and soft in consistency[16]. Nonetheless, less digestible casein proteins are believed to result in firmer stools, formula-fed infants tended to have more firmer stools and more frequent constipation problems[16]. According to this result, we can speculate that certain proteins in fish might be more digestible than proteins found in eggs, so more digestible proteins promote the formation of soft stools among elderly people. Further study is required to confirm this hypothesis.

To date, many studies have agreed that higher dietary fibers (fruits and vegetables) consumption decreases prevalence of constipation in different age and gender groups. According to our study, elderly people who consume fruits and vegetables frequently have lower prevalence of constipation ($P < 0.05$) (Table 4). The mechanism of action of fiber on constipation includes: (1) fiber increases stool bulk and accelerates colon transit; (2) fermenting fiber produces short-chain fatty acids (butyrate, propionate, acetate, *etc.*), which increase osmotic load and accelerate colon transit; (3) short-chain fatty acids change the intraluminal microbiome (mass) directly or indirectly by decreasing luminal pH, which accelerates colon transit; and (4) fiber contains water. All these improve stool consistency and amount[3-5]. Increasing soluble fiber intake by increasing fruits and vegetables consumption resulted in more frequent and softer stools[6]. Meanwhile, fruits and vegetables contain relatively higher amount of water than other food groups, Murakami *et al*[12] have indicated that low intake of water from foods was independently associated with increasing prevalence of constipation[12]. Therefore, frequent intake of fruits and vegetables is highly recommended to elderly people. Roma *et al*[17] have conducted a study on children in selected areas of Greece, and have observed that the mean daily fiber intake was lower in the parents of constipated children than in control parents. This implies that constipation is not "inherited" but "passed" in a family where eating habit is essential in both prevention and treatment of constipation. High prevalence of constipation among elderly is not only due to ageing processes, but dieting habit is also a key factor. Increase dietary fibers intake and modify eating pattern can both influence familial health status and potentially reduce incidences of constipation. Moreover, according to Sun Hwan Bae certain fruits such as pear, grape, plump, and apple with peel are useful in treating constipation due to their high fiber content[18]. Green kiwifruits, prune, persimmon and banana are commonly consumed and available in Asia, green kiwifruits and prune have beneficial effects on constipation yet raw persimmon and banana

pose negative effects on constipated patients. Green kiwifruit significantly increases defecation frequency, stool volume, softness of bowel motion, and ease of defecation in adult clinical studies[19]. Similarly, prune and Japanese apricot are beneficial to constipation; prune contains large amount of phenolic compounds which aid in laxative effect[20], and Japanese apricot increases defecation frequency and contraction of the rat colon[21]. Nevertheless, unripe persimmon contains high tannin concentration, tannin acid reduces intestinal secretions and inhibits peristalsis, and even healthy individuals experience painful defecation when ripe persimmons are eaten[18], persimmons should be avoided by constipated elderly people. Also, unripe bananas contain 100-250 mg tannins/100 g and have high amylase-resistant starch content; they can cause or aggravate pre-existing constipation[22]. Unripe banana should not be recommended to constipated elderly people, as many other sources of fibers are available. Additional examples in terms of which fruits can aggravate constipation require further study.

Our epidemiological investigation demonstrates that higher staple food (rice, wheat products) intake, frequent fruits and vegetables consumption, incorporation of fish into diet pose beneficial effect on constipation and reduce the prevalence of constipated patients. Increase dietary fibers intake from both fruits and vegetables and whole grains to alleviate symptoms of constipation is one of effective methods. A balanced diet should be promoted and emphasized as first line treatment prior to any medical intervention.

COMMENTS

Background

With an increasing trend of population aging in China, more elderly people will suffer from constipation. Aside from food abundance, more and more older people start to draw attention to healthy dieting to prevent various diseases. However, correlation between diet habits and morbidity of constipation is yet to be determined in China. The authors conducted an epidemiological study in Beijing with regards to diet habits and prevalence of constipation among elderly. China Chronic Constipation Diagnosis and Treatment Guideline (2013) were taken as standard reference with the following judgment indicators: decreased defecation frequency, dry and hard stool, and difficulty in defecation

Research frontiers

There has been little epidemiological study concerning correlation between diet habits and prevalence of constipation in Beijing among older population. This study has introduced significance of dietary modification in alleviating and preventing constipation prior to medical intervention. Further studies regarding dietary modification in relation to constipation should be emphasized and promoted

Innovations and breakthroughs

There has been no large sample epidemiological study of elderly constipation in the past decade in Beijing. There is little systemic research on epidemiology of constipation and diet habits. The authors carried out an epidemiological investigation regarding correlation between diet habits and prevalence of constipation among older population in Beijing.

Applications

The prevalence of elderly constipation in Beijing region is closely related to diet habits, and is significantly decreased by high staple foods intake, fish eating and high dietary fibres (fruits and vegetables) consumption.

Terminology

Constipation was defined according to the China Chronic Constipation Diagnosis and Treatment Guideline (2013), with the following constipation judgment indicators: decreased defecation frequency, dry and hard stool, and difficulty in defecation.

Peer-review

The study "Epidemiological study: correlation between diet habits and constipation among elderly in Beijing region" is very interesting.

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