



Research Paper

Role of Diet and Body Mass Index on the pattern of bowel habits among students

Authors

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Abstract

Background: *The pattern of bowel habits, as well as functional bowel disturbances tend to vary among different populations and is influenced by factors such as diet and body mass index. Assessing the bowel habits in a population will help to determine the normal defecatory pattern in that population and introduce lifestyle and dietary modifications to regularize bowel function*

Aims and Objectives: *This study was conducted among the students of a tertiary care hospital in Kerala to study i) the bowel habits and subjective bowel disturbances among students.ii)study the association of factors such as body mass index and diet with the pattern of bowel habits in the same population.*

Methods: *Details were collected from 600 participants, regarding stool pattern, bowel symptoms and consumption frequency and amount of different food items. Height and weight was recorded and BMI calculated. Chi- square analysis was done for qualitative data.*

Result: *The predominant stool form was Bristol type 3 stool (sausage shaped stools with cracks on the surface) according to Bristol stool chart and the median stool frequency was 1-2 per day or 7-14 times per week. Water and vegetable consumption was associated with softer stool consistency. Consumption of vegetables was also associated with more frequent stool and less symptoms of abdominal discomfort. Consumption of chocolates was associated with hard stools while coffee consumption was associated with reduction in stool frequency. Increased milk consumption was associated with watery stool consistency.*

Conclusion: *Inclusion of more vegetables in diet, drinking adequate water and limiting the intake of coffee ,chocolates and milk will help to regularize bowel moments*

Keywords: *Diet, bowel, stool, water, vegetables.*

Introduction

The pattern of bowel habits tend to vary among different populations, depending their diet and life style¹. Bowel habits are difficult to assess because of their highly private nature².A stool frequency of 3-

21/ week is considered normal in Western populations, but many Asian studies have reported a higher frequency.^{1,2}

Studies assessing the patten of bowel habits are useful in recognizing a deviation from normal, to evaluate lower gastrointestinal disorders and to

advise lifestyle and dietary modifications to regularize bowel habits. However, there are few studies in India pertaining to bowel habits. A study conducted among apparently healthy subjects in Cuttack, Orissa, showed a stool frequency of 14 per week (range 2-42).¹ A similar multicentre study conducted by Goshal U.C in India reported that 90 per cent of normal subjects in the study had a stool frequency of 1-2 per day.³

Frequency of defecation is easy to assess but is a poor determinant of colonic function, on the other hand, stool consistency correlates well with transit time and fecal output.²

Body mass index (BMI), which is the body weight (in kilograms) divided by the square of height (in meters) is a convenient and reliable indicator of body fat. According to BMI subjects were categorized as underweight (BMI<18.5), normal (BMI≥18.5 and<25), over weight. (BMI-25-29.9) and obese (BMI≥30). Several studies have shown that, body mass index tend to influence bowel habits.⁴ A study conducted at Harvard School of Public health, found that BMI was inversely related to constipation. According to a study conducted in Tokyo to determine the association between BMI and intraabdominal fat measured by CT scan, both low BMI and low abdominal fat accumulation were found to be associated with, hard stools.⁵

Several population based studies have also shown an association between obesity and frequent loose stool.⁶⁻⁷

Water: Studies have shown that inadequate fluid intake is associated with chronic constipation.⁸ In a study conducted by B Miguel A Sanjoaquin et al, it was found that both men and women had more bowel movements on increasing intake of fluid.⁹

Another study showed that in individuals who are not adequately hydrated, drinking more water can increase stool frequency thus enhancing the beneficial effect of daily dietary fibre intake.¹⁰

Vegetables: In the study conducted in Cuttack it was observed that those who consumed vegetarian diet passed softer and more frequent stools. Increasing dietary fiber was also associated with shorter transit, more frequent stools and softer stool forms.¹ A study

from UK showed that the mean bowel frequency was higher in vegetarians, and especially in vegans compared with participants who regularly ate meat.¹¹

Coffee Studies have shown that excess coffee consumption can cause constipation in the long run due to its diuretic effect which can cause dehydration and hard stool.^{12,13} However some studies have also shown that coffee promotes the release of gastrin which can increase the colonic spike and motor activity and hence motility and a desire to defecate.¹⁴

Tea: A study conducted in Denmark showed that, an increase in tea consumption among study subjects resulted in a slight reduction in fecal mass, probably due to the theophylline content that caused dehydration and a secondary increase in intestinal fluid resorption and hence constipation.¹⁵

Confectionaries and chocolates .A study conducted in Tokyo among young women showed that the prevalence of constipation increased with greater intake of confectioneries and there was a positive relationship between bread intake and constipation.¹⁶ Another study conducted by Muller Lissner SA et al among German individuals showed that chocolates may cause constipation.¹⁷

Milk: Patients suffering from irritable bowel syndrome (IBS) often relate their symptoms to milk. In adult populations "lactose intolerance", is the most common cause of gastrointestinal symptoms such as bloating and loose stool induced by cow's milk.¹⁸

Irritable Bowel Syndrome (IBS) is a functional disorder of the bowel characterized by abdominal discomfort or pain and altered bowel habits in the absence of detectable structural abnormalities. Although there is no permanent cure for IBS is known, there are several measures to relieve the symptoms of IBS, including dietary adjustments, medication, and psychological interventions.¹⁹ Dietary measures that have been found to be effective include increasing soluble fiber intake.²⁰

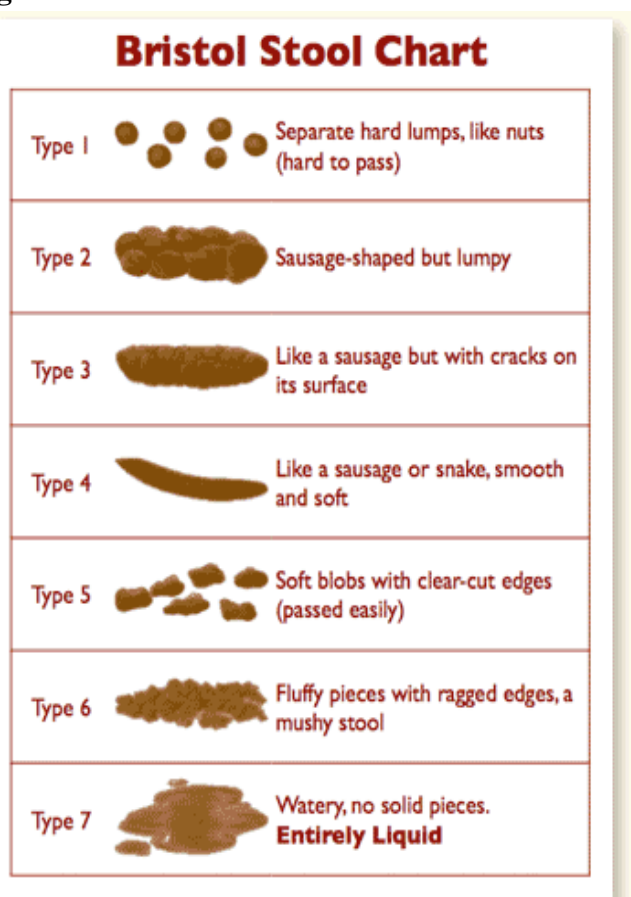
Aim of the Study

- i. This study was conducted among the students of a tertiary care hospital in Kerala to study i) the bowel habits and subjective bowel disturbances among students.
- ii. Study the association of factors such as body mass index and diet with the pattern of bowel habits in the same population.

Methods

1. In this descriptive study, participants filled out self-administered questionnaires, which included questions regarding, food habits, stool frequency, stool type and subjective gastrointestinal disturbances. Questions regarding stool type was accompanied by Bristol stool chart (a medical aid designed Dr Ken Heaton, that categorizes human feces into seven types).

Fig 1 Bristol stool chart



Based on the Bristol stool chart, stool can be broadly classified as **hard stool** (type 1 and 2), **normal soft stool type** (3, 4 and 5) and as **watery stool** (type 6, 7). Questions regarding subjective gastrointestinal

symptoms were based on Rome III criterion, a system developed to classify the **functional gastrointestinal disorders (FGIDs)**

Questions regarding diet included:

- a) Type of diet, (vegetarian/nonvegetarian)
- b) Water intake per day (1 glass approximately = 200ml)
- c) Consumption frequency and amount of various food items such as, vegetables (1 serving = 50 grams approximately), tea, coffee (1 cup = 150 ml approximately), milk (1 glass approximately = 200ml), chocolates, fish, fried items, confectionaries and bakery products.

From a previous study assuming that stool type 6 has a prevalence of 15 %, a sample size was calculated using the formula,

$$\frac{4pq}{L^2} = \frac{4 \times 15 \times 18}{3 \times 3} = 566$$

A sample size of 566 was obtained which was rounded off to 600. Data was then collected from 600 study participants.

Persons unwilling to participate in the study and known cases of organic lower bowel disturbances were excluded from the study

Data Analysis

Descriptive analysis done for the stool pattern. Chi-square analysis was done for qualitative data. P-values below 0.05 was considered significant for all statistical analysis. Data entered in Microsoft Excel. Statistical analysis done with SPSS version 17.0

Results

Total number of participants in the study was 600. Study participants were in the age group of 17 to 25 years.

21% of respondents were male and 79% were female. (Table 1) 66.6% of participants had a normal weight, with BMI between 18.50 and 24.99. 20.5% were underweight and 12.9% were overweight or obese. However no significant association was found in this study between BMI and stool frequency or stool type.

In this study it was seen that the predominant stool type was type3 (according to the Bristol stool chart) followed by type 4(Table1) which is in slight contrast to the study done at Cuttak and several other studies where type 4 is the predominant type¹ (Table1) 91.2% of the study population had a stool frequency of 1-2 per day or 7-14 stools per week, on an average. 1.9% passed stool more than two times daily that is more than 14 stools per week .6.9% reported that they were not passing stool everyday amounting to a frequency of less than 7 per week.

395 respondents (65.83%) of the study population had no symptoms of abdominal discomfort. Of the 196 study subjects who reported abdominal symptoms 138 (33.7%) respondents had more than one complaint (.Table2)

Water Consumption: 51.1% of the study subjects drank 8 or more glasses of water (1 glass approximately = 200ml) per day where as 48.9% of the population drank less than 8 glasses of water daily. The quantity of water consumed was found to be significantly associated with softer stool consistency. 88.4% of respondents who were consuming 8 or more glasses of water daily were passing normal soft stools most often compared to 73.7% in the group that drank less than 8 glasses daily. (Table3)

This finding is similar to studies that have shown that inadequate fluid intake is associated with chronic constipation and that that in individuals who are not adequately hydrated, drinking more water can increase stool frequency^{12,14}. However water intake was not found to have a statistically significant association with stool frequency.

Vegetable Intake

38.2% of the population stated that they were consuming more than 2 servings (one serving= 50grams approximately) of vegetable daily, whereas 61.8% of the population said that they were taking only 2 or less servings of vegetable daily. (Table 4). A strong positive association was obtained between quantity of vegetables consumed and soft stool (p<0.001).

A significant positive association was also found between the quantity of vegetables consumed and the

frequency of bowel movement (p=0.005). These findings are similar to that of several other studies, including the one done at Cuttak which showed that those who consumed vegan and vegetarian diet passed softer and more frequent stools.¹ (Table5)

It was also observed that the symptoms of abdominal discomfort was more among those consuming less vegetables. Symptoms of frequent abdominal distention, straining at stool and incomplete evacuation of stool was found to be significantly associated with lesser vegetable consumption. (Table 6)

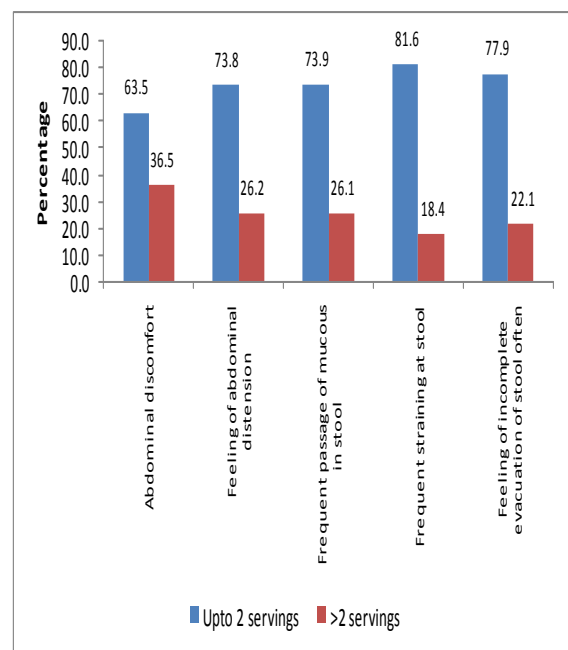


Fig. 2 Comparison of Biological symptoms abdominal discomfort based on consumption of vegetables

Milk: An association was also found between milk consumption and watery stool type (p=0.004). 16.7% of subjects who were taking more than 200 ml of milk daily were found to have watery stool (type 6,7) as their most common stool type, compared to 3% in those who were taking less than 200ml per day and 3.6% in those who were not taking milk daily.

This correlates well with several studies that show that drinking milk can result in watery stool especially in those with lactose intolerance.

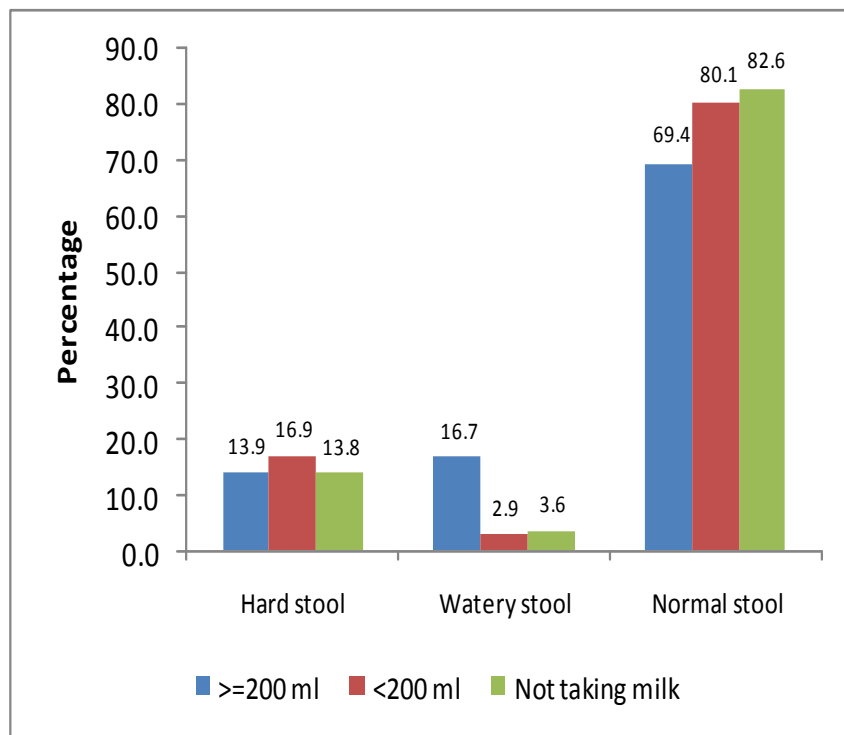


Fig. 3 Comparison of stool type based on consumption of milk

Chocolates: A significant association was found between the consumption of chocolates and the hard stool type ($p=0.015$). 26.1% of those who were consuming chocolates daily stated that they were having frequent hard stool compared to 13.0% in the group that were taking chocolates only occasionally. However significant association was not obtained between stool frequency and chocolate consumption

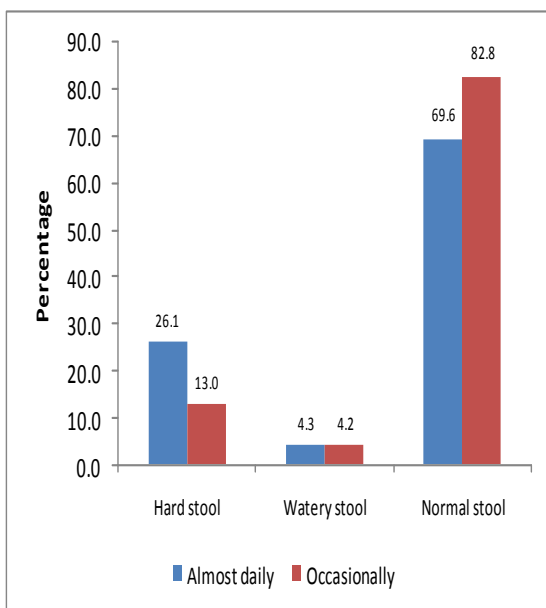


Fig 4 Comparison of stool type based on consumption of chocolates

Coffee Consumption: 26.7% of respondents reported that they were taking 1-2 cups of coffee daily, (1cup≈150 ml). 2.9% of subjects were taking more than 2 cups daily whereas 70.4% of the population stated that they were not taking coffee daily. (Table 7)

A significant association was also found between coffee consumption and stool frequency ($p=0.046$), with respondents who were consuming more coffee having less stool frequency. 23.5% of those who were consuming more than 2 cups of coffee were not passing stool daily compared to 6.3% in the group who were not taking coffee every day. This finding is similar to some other studies, such as the one conducted by Sandler et al in the US which showed that excess coffee can cause constipation in the long run due to its diuretic effect which can result in dehydration and hard stool although coffee induced an immediate desire to defecate^{8,10}

No correlation was found between bowel habit and dietary variables such as tea, fish and bakery products.

Table 1 Distribution of the Study group according to stool type (as per Bristol stool chart)

Bristol stool chart	Frequency	Percentage
Separate hard lumps (Type-1)	10	1.7%
Sausage shaped,lumpy (Type-2)	79	13.2%
Sausage shaped with cracks (Type-3)	239	39.9%
Sausage shaped, smooth, soft (Type-4)	192	32%
Soft blobs with clear cut edges (Type-5)	50	8.3%
Mushy stool (Type-6)	29	4.7%
Entirely liquid (Type-7)	1	0.2%
Total	600	100%

Table 2 Distribution of subjective symptoms in study group

	Frequency	Percentage
No frequent abdominal discomfort	395	65.83%
Abdominal discomfort/cramps usually relieved on passing stool,almost daily	74	12.33%
Feeling of abdominal distension frequently	84	14%
Frequent passage of mucous in stool	23	3.83%
Frequent straining at stool	76	12.66%
Feeling of incomplete evacuation of stool often	77	12.83%

Table 3 Comparison of stool type based on glasses of water consumed on an average daily

	Glasses of water consumed on an average daily				χ^2	p
	< 8 glasses		≥8 glasses			
	Frequency	Percentage	Frequency	Percentage		
Hard stool	62	21.1	25	8.3	21.87**	0.000
Watery stool	15	5.2	10	3.3		
Normal(soft) stool	216	73.7	272	88.4		
Total	293	100%	307	100%		

**:- Significant at 0.05 level

Table 4 Comparison of stool type based on consumption of vegetables

Stool type	Consumption of vegetables				χ^2	p
	Upto 2 servings		>2 servings			
	Frequency	Percentage	Frequency	Percentage		
Hard stool	73	20.0%	13	5.8%	23.94**	0.000
Watery stool	17	4.7%	8	3.5%		
Normal(softstool)	275	75.3%	205	90.7%		

**:- Significant at 0.01 level

Table 5 Comparison of stool frequency based on consumption of vegetables

Stool frequency	Consumption of vegetables				χ^2	p
	Upto 2 servings		>2 servings			
	Count	Percent	Count	Percent		
>2 stool per day	9	2.5	2	0.9	10.58**	0.005
Not passing stool daily	34	9.3	7	3.1		
1 – 2 stool per day	322	88.2	217	96.0		

**:- Significant at 0.01 level

Table 6 Comparison of Biological symptoms abdominal discomfort based on consumption of vegetables

Biological symptoms	Consumption of vegetables				χ^2	p
	Upto 2 servings		>2 servings			
	Count	Percent	Count	Percent		
Abdominal discomfort	47	63.5	27	36.5	0.11	0.740
Feeling of abdominal distension	62	73.8	22	26.2	6.02*	0.014
Frequent passage of mucous in stool	17	73.9	6	26.1	1.5	0.221
Frequent straining at stool	62	81.6	14	18.4	14.51**	0.000
Feeling of incomplete evacuation of stool often	60	77.9	17	22.1	9.79**	0.002

*: -Significant at 0.01 level, *: - Significant at 0.05 level

Table 7: Comparison based on coffee consumption Significant at 0.05 level

Stool frequency	Coffee consumption						χ^2	p
	>2cups every day		1 - 2cups everyday		Not taking coffee every day			
	Frequen cy	Percent age	Frequen cy	Percent age	Frequen cy	Percent age		
>2 stool per day	0	0.0	5	3.2	6	1.4	9.67*	0.046
Not passing stool daily	4	23.5	11	7.0	26	6.3		
1 – 2 stool per day	13	76.5	142	89.9	384	92.3		

Conclusions

The predominant stool form in the study population was found to be Bristol type 3 stool (as per Bristol stool chart) and the median stool frequency was 7-14 times per week. A positive association was also obtained between stool type and dietary factors such as water and vegetable consumption, with most participants who were taking more water vegetables and passing softer forms of stool. Vegetable consumption was also associated with more frequent stool. It was also observed that the symptoms of abdominal discomfort was more among those consuming less vegetables

A significant association was found between the consumption of chocolates and hard stools. Coffee consumption was associated with reduced stool frequency. Milk consumption was associated with watery stool consistency. No association was found with other dietary variables.

Even though several studies have shown an inverse relationship between BMI and stool type no significant association was found in this study between BMI and stool frequency or stool type.

Therefore it can be stated that, inclusion of more vegetables in diet, drinking adequate water and

limiting the intake of coffee chocolates and milk will help to regularize bowel moments.

Limitation of the study

All the data obtained was self reported. Causal relationship with variables could not be determined. Several other life style related factors like stress, which could influence bowel habit have not been included in the study.

Acknowledgements: Nil

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