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* **Corresponding author**.

sreemathy@gmail.com

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Assessment of Dietary Fiber Intake in Adults: Consideration of Gender and Age Disparities

Sreemathy Venkatraman[1]*, **Triveni Kandhi**[2]

1 Department of Nutrition and Dietetics, Trustwell Hospitals, Bangalore, Karnataka, India
2 Dr. Satyaprakash Digestive Health Centre, Bangalore, Karnataka, India

Abstract

Background: Many studies have focused on the health effects of dietary fibre. Despite the advice of numerous experts to increase fibre consumption, many population groups have failed to meet the recommended daily average intake, which may lead to the development of various chronic diseases. **Objectives:** This study aimed to gain insight into the dietary fibre intake of adults in the Indian population. **Methods and Materials:** A questionnaire-based survey was conducted on 800 adults. A structured questionnaire containing 12 questions was used to collect data from the study participants. Data were analysed using statistical methods, and the outcomes were presented and interpreted. **Results:** A total of 800 participants (621 females and 179 males) were surveyed. A significant association was found between daily fruit intake and age (p=0.000) and gender (p=0.009). A significant association was observed between the consumption of daily 2 cups of vegetables and age (p=0.000) and gender (p=0.289). The majority of participants (57.61%) had fruits in the evening between lunch and dinner. The majority of females (281) had two cups of vegetables daily, followed by males (73). Approximately 32% of the participants consumed green leafy vegetables 2 times a week, and 27% consumed vegetables once a week. Of the 800 participants, 11% experienced constipation, 62% used digestive biscuits, and 85% did not use fibre supplements to relieve constipation. **Conclusion:** The findings showed age and gender differences in adult fibre consumption, highlighting the critical role that dietary fibre plays in maintaining good health and well-being.

Keywords: Age; Gender; Dietary fibre; Questionnaire; Survey

1 Introduction

The advantages of consuming dietary fibre (DF) have been acknowledged for some time. A diet high in fibre can lessen the likelihood of developing certain illnesses, including obesity, cancer, diabetes mellitus, and cardiovascular diseases.[1] Furthermore, dietary fibre can enhance

stool consistency by softening it and increasing its bulk, allowing for easier passage through the intestine. Taking a sufficient amount of fibre can therefore help to decrease the likelihood of experiencing stool issues like constipation and its severity.[2] Constipation is a common issue that affects a significant portion of the population, with its prevalence ranging from 5% to 20% based on the definition applied.[3]

DF comprises a variety of complex carbohydrates that are essential for public health, as they are often under-consumed nutrient in comparison to the recommended intake in many countries around the world.[4] DF is related to the promotion of the mitigating effects on cholesterol and glucose levels,[5,6] with the latter being related to the onset of type 2 diabetes,[7,8] obesity, colon cancer,[9] and cardiovascular diseases;[10] it takes part in all of the digestive system functions, from mastication to the faeces elimination, and in general, DF offers various health benefits. These include improvements in gut health (softening of faeces, increase in faecal loading, fermentation, and decrease in faecal pH), insulinemic and glycaemic control, reduction of cholesterol (LDL-cholesterol and total cholesterol), weight control (increase in satiety and reducing caloric intake), and an effect on the metabolic function of the different microbial species that colonize the gastrointestinal tract, to improve human health and potentially prevent or treat diseases in general.[11]

A daily fibre intake of 30 g per 2000 kcal is recommended by the ICMR because of these known health-promoting effects.[12] Moreover, the majority of the population does not consume the recommended daily vegetable and fruit intake, which are important sources of fibre in the diet. Intervention studies have been performed to assess the health effects of fibre in different study populations, or to improve the fibre intake or intake of high-fibre food categories for prevention measures or treatment of, for example constipation.[13] The criteria for participating in these studies typically involve having a diet low in dietary fibre, with the aim of providing an opportunity to increase fibre intake towards recommended levels, which necessitates dietary screening during the selection process. Dietary evaluation methods, such as food frequency questionnaires (FFQs) and 24-hour recalls, are commonly utilised in screening, but they can be labour-intensive, expensive, and more elaborate than strictly necessary for screening purposes.[14] This places an unnecessary burden on both the participant and researcher.

To date, several short dietary screening questionnaires have been developed for various purposes. Certain screening questionnaires are specifically designed to assess the likelihood of developing certain diseases, such as obesity in children, malnutrition in the elderly, or cardiovascular disease, by examining dietary intake. However, these questionnaires are not suitable for evaluating fibre intake in healthy or constipated adult populations. In general, the recommended daily intake of DF for adults is between 18-38 grams per day;[15] however, the global average does not exceed 20 grams per day.[16] The availability of information regarding food consumption in India is limited, particularly in relation to the measurement of fibre intake. The provision of reliable tools to evaluate food consumption, especially regarding high-fibre foods, would enable the quantification of fibre intake, identification of vulnerable groups and target populations, and formulation of public policies and programs aimed at enhancing population health. Therefore, this study aimed to survey dietary fibre intake in adults using a fibre-specific screening questionnaire.

2 Materials and Methods

2.1 Study Setting

A structured survey was conducted using a questionnaire consisting of voluntary consent from 800 adults to participate in the survey for a period of three months. Among the 800 participants, 90% were from India, while 10% were from UK, UAE, as well as USA. All study participants were required to fill in an online questionnaire proforma designed for the study. A questionnaire was prepared that contained 12 questions related to fibre intake in the form of fruits, vegetables, as well as fibre supplements in the diet of adults. The questionnaire was analysed and validated by four experts. As the data collected were unidentifiable, no external agency approval was deemed necessary. The answers to the questionnaire were analysed and interpreted.

2.2 Data Analysis

All captured data were entered into an Excel spreadsheet and all statistical analyses were performed using SPSS software version 20 (Statistical Package for Social Sciences, IBM Corp. Armonk, NY, USA). Descriptive statistics of the explanatory and outcome variables were calculated using frequencies and percentages. Inferential statistics, such as the chi-square test, were applied for categorical variables. The level of significance was set at 5%.

3 Results

Of the 800 participants, 621 were female and 179 were males. The majority of the study participants (564) belonged to the < 40 years age group, followed by 201 participants in the age group of 40-60 years. The chi-squared test was used to check the association between daily fruit intake with age and gender which showed a significant association with age group (p=0.000) and gender (p=0.009). Of 800 participants, 261 participants aged < 40 years had fruits daily, followed by 135 participants aged 40-60 years and 25 participants aged >60 years had fruits daily. The chi-square test was used to check the association between intake

of daily 2 cups of vegetable intake with age and gender which showed a significant association with age (p=0.0000) and non-significant association with gender (p=0.289). The gender- and age-group-wise intake of fruits and vegetables are shown in Table 1.

Approximately 33% of participants consumed fruit on a daily basis, 20% consumed fruit on alternate days, and approximately 14% consumed fruit once a week. Most study participants (57.61%) had fruits in the evening between lunch and dinner, and approximately 51% had fruits in the mid-morning between breakfast and lunch. Daily fruit consumption was noted in the majority of participants (53%), followed by participants (20%) who consumed fruit on alternate days. One cup of fruit was consumed by 51% of the study participants, and approximately 44% of the study participants had two cups of vegetables daily. Participants who were < 40 years old (228) consumed $\frac{1}{2}$ cups of vegetables daily. Based on gender, most females consumed vegetables when compared to males, where around 281 females consumed two cups of vegetables daily and 69 male participants consumed only one cup of vegetables daily. Approximately 32% of the study participants consumed green leafy vegetables 2 times a week and 27% consumed vegetables once a week. (Table 2)

Among the 800 (100%) participants, approximately 11% were affected by constipation. Approximately 62% of the study participants consumed digestive biscuits and approximately 85% did not take fibre supplements to relieve constipation. Regarding the intake of fibre supplements, most study participants (483) in the < 40 years age group, 171 in the 40-60ys years age group, and 28 in the >60 years group never had fibre supplements. Detailed responses of participants on consumption of fruits, vegetables, and fibre supplements regarding frequency and quantity are tabulated in Table 2.

Table 1. Gender and age variables in vegetable and fruit consumption (n=800)

Gender	**Daily fruit intake**	**Intake of fruit not daily**	**Total**	**p values at 1 df and 99% CI**
Males	80	99	179	
Females	345	276	621	0.009*
Total	425	375	800	
Age	**Daily fruit intake**	**Intake of fruit not daily**	**Total**	
< 40 years	261	303	564	
40-60 years	135	66	201	0.000*
>60 years	25	10	35	
Total	421	379	800	
Gender	**Daily 2 cups of vegetables intake**	**Not having 2 cups of vegetables daily**	**Total**	
Males	73	106	179	
Females	281	340	621	0.289
Total	354	446	800	
Age	**Daily 2 cups of vegetables intake**	**Not having 2 cups of vegetables daily**	**Total**	
< 40 years	228	336	564	
40-60 years	106	95	201	0.003*
>60 years	20	15	35	
Total	354	446	800	

*Significant

4 Discussion

According to our understanding, no reference questionnaires have been developed to date for quantifying dietary fibre intake in the Indian population. This lack of reference questionnaires makes it challenging to classify users based on their dietary fibre intake and its association with various health events, some of which are influenced by lower or higher intake of dietary fibre. This study aimed to understand the intake of dietary fibre in adults, revealing gender differences.

Of the 800 participants, 53% consumed fruits daily, 20% alternated daily, and 14% only once a week. This indicates a high awareness of fruit intake in daily diets. Approximately 58% consumed fruits in the evening, between lunch and dinner, whereas 51% consumed fruits mid-morning, between breakfast and lunch. 51% consumed one cup of fruit daily, whereas 33% consumed two cups daily. Females (55.07%) consumed more fruits daily than males (44.13%), indicating greater awareness of healthy dietary habits in females than male participants. In the Irish elderly population,[17] women consumed less dietary fibre than men, but their intake of dietary fibre per energy intake was higher than in men, and we observed that the intake of fibre was higher in females compared than in males. A Dutch study on adults (19–69 years),[18] also reported higher fibre intake in women than males. Females also consumed fruit more regularly than males. The daily consumption of fruits increased with age, as a greater number of participants aged 60 years or above consumed fruits on a daily basis compared to those under 60 years of age.

The recommended amount of fibre is based on energy intake. According to the ICMR-NIN, 2020, a fibre intake of 30 grams per 2000 kcal is considered safe. The USDA Dietary Guidelines for Americans recommend that women consume 25-28 grams per day of fibre, while men should consume

Table 2. Questions related to fruit, vegetables and fiber consumption

1. Frequency of fruit consumption	
Daily	33%
Alternate days	20%
Once a week	14%
Never	0%
2. Time of fruit consumed in a day	
At breakfast	15.84%
Mid-morning between breakfast and lunch	51%
Evening between lunch and dinner	57.61%
After dinner	17.58%
I don't eat fruits	2.62%
3. Frequency of consumption of fruits	
Daily	53%
Alternate day	20%
Two times a week	13%
Once a week	14%
Never	0%
4. Portion of fruits consumed in a day	
$\frac{1}{2}$ cup	9%
1 cup	51%
2 cups	33%
3 cups	6%
None	1%
5. Portion of vegetables consumed in a day	
$\frac{1}{2}$ cup	14%
1 cup	40
2 cups	44%
None	2%

6. Daily consumption of vegetables based on age groups

Cups	**< 40 years**	**40 – 60 years**	**> 60 years**
1/2 cup	228	106	20
1 cup	15	106	0
2 cups	95	17	1
None	226	76	14

7. Daily consumption of vegetables based on gender

Cups	**Female**	**Male**
1/2 cup	85	28
1 cup	247	69
2 cups	281	73
None	8	9

8. Consumption of green leafy vegetables	
Daily	7%
Alternate day	18%
Two times a week	32%
Once a week	27%
Never	3%
9. Participants affected by constipation	
Yes	11%
No	89%
10. Consumption of digestive biscuits	
Yes	62%
No	38%
11. Consumption of fiber supplements to relieve constipation	
Daily	2%
Alternate days	1%
Only if have constipation	12%
Never	85%

12. Consumption of fibre supplements – Age differences

Frequency	**<40 years**	**40-60 years**	**>60 years**
Daily	8	3	3
Alternate days	9	2	0
Only if have constipation	64	25	4
Never	483	171	28

31-34 grams per day. Similarly, the American Diabetes Association advises patients with diabetes to consume the same amount of fibre as the general population. No particular recommendations have been made regarding the ideal types of dietary fibres. However, it is suggested that half of all grains consumed should be whole grains, and it is acknowledged that a daily fibre intake of over 50 grams is challenging to achieve without the use of dietary fibre supplements. [19,20]

The present study observed that 44% of the participants consumed two cups of vegetables daily, while 40% consumed one cup. As individuals aged, their daily vegetable intake increased, with a larger proportion of participants over 60 consuming two servings of vegetables per day than those under 60. There was no marked dissimilarity in the daily consumption of vegetables between the male and female participants. Green leafy vegetables were consumed either once or twice a week, with only 7% eating them daily and 18% consuming them alternately.

Approximately 11% of the study participants suffered from constipation, and among them, 38% consumed digestive biscuits as a dietary fibre source. Most participants never had digestive supplements to relieve constipation, whereas

12% had supplements only. Differences in age were also a factor, as a greater proportion of individuals over 60 years old consumed digestive supplements daily than those under 60 years old.

There is ample evidence that fibre is important for maintaining blood sugar levels (low glycaemic index [GI]), triglycerides, and cholesterol levels (binding by fibre components and increased excretion), and regulatory bodies such as the FDA have approved health claim labels for many sources of good fiber.[21] The industrialization and fast lifestyle have steadily altered the diet, as well as fibre intake is minimal. Thus, the primary reasons for reduced fibre intake were increased daily calorie intake, refined flour consumption, and a decrease in the consumption of high-fibre breads such as oat, granola, barley, as well as wheat-based varieties. Each country has its own distinct dietary habits; for example, some diets, like the Mediterranean and Japanese diets, are viewed as beneficial for health, while others, such as the Western diet, contain high levels of saturated fats and are low in fibre, leading them to be seen as unhealthy.[22]

The intake of dietary fibre has diminished, while the consumption of sugar and animal protein has augmented, and the variety of microorganisms in the gut microbiome of humans has lessened. These occurrences could potentially disrupt the microbiome's capacity to generate short-chain fatty acids (SCFAs), which may consequently contribute to the development of chronic inflammatory diseases. This finding emphasises the necessity of deliberately including foods with high fibre in our daily lives. Dietary fibre has been given scientific recognition that it warrants. Consuming a substantial amount of dietary fibre has been shown to significantly decrease the likelihood of developing ailments, such as coronary heart disease, stroke, hypertension, diabetes, and obesity, as well as certain gastrointestinal disorders. Increased fibre intake decreases serum cholesterol as well as blood pressure. In both diabetic as well as non-diabetic patients, increasing soluble fibre consumption increases glycaemia and insulin sensitivity. Thus, increasing dietary fiber in our daily life is essential and must be done promptly and consistently.[23]

To improve the daily intake of dietary fibre, it is vital to provide nutritional information. When selecting food, it is essential to consider fibre content labelling. This information is crucial for consumers' food choice behaviour and can influence food selection, leading to better health outcomes. Employing non-digestible carbohydrates in fortified foods or dietary supplements is a method can be followed to enhance the fibre intake.[24]

5 Conclusion

This study demonstrated the relationship between adult fibre intake and food habits, revealing gender differences and increased awareness of dietary fibre. Females had significantly higher daily fruit intake than males. Age significantly influenced the participants' intake of fibre, fruits, and vegetables and increased with age. Digestive biscuits were used as dietary fibre supplements. The study also found awareness of the link between fibre intake and constipation, with participants taking fibre supplements to relieve constipation. Further research is needed to understand the factors affecting the dietary intake of fruits and vegetables in the adult population.

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