The Impact of Dietary Fiber Intake on Gastrointestinal Health - Among the General Population in Mumbai (Kandivali) Region through an Educational Intervention

Jeba Jenisha[1]

[1] Student, School of Sports Exercise and Nutrition Sciences, DY Patil Deemed To Be University, Navi Mumbai, Maharashtra, India

ABSTRACT

Dietary fiber plays a crucial role in maintaining optimal gastrointestinal (GI) health by supporting digestion, regulating bowel movement, and promoting beneficial gut microbiota. This study aimed to assess the impact of dietary fiber intake on gastrointestinal health among the general population in the Kandivali region of Mumbai through an educational intervention. A total of 80 participants were surveyed to evaluate baseline fiber consumption and related GI symptoms using a structured questionnaire. Following an educational session on fiber sources, benefits, and daily requirements, participants' dietary patterns and GI health outcomes were re-evaluated. Statistical analysis revealed a significant improvement in fiber awareness, intake levels, and reduction in common GI complaints such as constipation, bloating, and irregular bowel movement. The intervention effectively enhanced participants' understanding of fiber's role in digestive wellness. This study highlights the importance of nutrition education as a practical approach to improving gastrointestinal health and promoting preventive nutrition within community settings.

Keyword: - *Dietary fiber; Gastrointestinal health; Educational intervention; Nutrition education; Gut microbiota; Mumbai population*

1. INTRODUCTION

Good digestive health is vital for overall well-being as it supports digestion, nutrient absorption, immunity, and even mental health [1]. Dietary fiber, mainly found in plant-based foods such as fruits, vegetables, whole grains, legumes, nuts, and seeds, plays a key role in maintaining digestive function [2]. It adds bulk to stool, promotes regular bowel movements, supports beneficial gut microbiota, and reduces the risk of constipation, irritable bowel syndrome (IBS), diverticulosis, and colorectal cancer [3]. However, fiber intake remains lower than recommended, particularly in urban populations where processed and refined foods are commonly consumed [4]. This study aims to evaluate the impact of an educational intervention on dietary fiber intake and gastrointestinal health among the general population in the Kandivali region of Mumbai. Baseline dietary habits and digestive health status were assessed, followed by a nutrition education program highlighting the importance and sources of dietary fiber. Post-intervention analysis measured changes in fiber intake and gastrointestinal outcomes.
The findings are expected to demonstrate improved fiber awareness, increased consumption, and enhanced digestive health. This research underscores the importance of nutrition education as an effective community strategy to promote fiber-rich diets and prevent digestive disorders [5].

2. OBJECTIVES

2.1 Primary Objective

Evaluate the current levels of dietary fiber intake and identify the prevalence and types of gastrointestinal issues (e.g., constipation, bloating, indigestion) in the general population of the Kandivali region

2.2 Secondary Objective

1. Investigate the relationship between fiber intake and gastrointestinal health outcomes (e.g., bowel regulation, constipation).
2. Measure changes in GI symptoms (e.g., bowel regulation, constipation) following the intervention

3. REVIEW OF LITERATURE

Dietary fiber plays a vital role in maintaining gastrointestinal and overall health by regulating bowel function, supporting beneficial gut microbiota, and reducing inflammation [1,2]. It enhances digestion, promotes nutrient absorption, and protects against gastrointestinal disorders such as constipation, irritable bowel syndrome (IBS), inflammatory bowel disease (IBD), and colorectal cancer [3,4]. Fiber also contributes to systemic benefits, including improved glycemic control, cholesterol regulation, and reduced chronic disease risk [5,6].

Different types of fiber exhibit distinct physiological effects—soluble fiber forms gels that slow digestion and regulate glucose and lipid levels, while insoluble fiber adds bulk to stool and promotes intestinal motility [7,8]. Fermentation of fiber by gut microbiota produces short-chain fatty acids (SCFAs), which strengthen mucosal integrity and modulate immune and metabolic functions [9,10].

Despite well-established evidence, fiber consumption remains suboptimal, particularly in urban areas where processed foods dominate diets [11]. Nutrition education, food labeling, and culturally relevant interventions have shown to improve fiber awareness and intake [12,13].

This study highlights the importance of promoting traditional, fiber-rich foods and public health strategies to address knowledge and behavior gaps. Dietary fiber, beyond aiding digestion, acts as a cornerstone of preventive nutrition—linking gut health, metabolic regulation, and chronic disease prevention to enhance overall well-being [14,15].

4. METHODOLOGY

4.1 Study Design - The study was an Interventional cohort study
4.2 Study Setting / Site - The study was conducted in Kandivali region
4.3 Study Duration - The study was for 3 months, focusing on the general population with a follow-up period of 30 days. The Ethical clearance was obtained from the Institutional Ethical Committee prior to data collection
4.4 Study Population - The study involves general population (Adults aged between 18 - 50 years) residing in kandivali region
4.5 Sampling Procedure - The study was conducted by convenience sampling
4.6 Sample Size - The sample size was 102 participants
4.7 Selection Criteria -

Inclusion Criteria	**Exclusion Criteria**
Residents of the Kandivali region	Laxative consumption
No pre-existing chronic gastric conditions (Celiac disease, IBD)	Individuals with diagnosed chronic gastric disorder (Crohn's disease, IBS)
	Pregnant women

4.8 Development of Tool -
The study employed a pre- and post-intervention questionnaire to assess changes in dietary fiber intake and gastrointestinal (GI) health among participants. The questionnaire included demographic details (age, gender, education, occupation, and food habits), an 18-item validated fiber screening section to evaluate frequency of fiber-rich food consumption, and a GI symptom assessment covering areas such as stomach function, inflammation, small intestine and pancreas health, and colon-related issues. Participants with low fiber intake and frequent GI discomfort were selected for the educational program.

A fiber-focused educational tool was developed in English and Hindi to enhance understanding of fiber and its role in digestive health. It explained soluble and insoluble fiber, their food sources, daily recommended intake, and practical ways to include them in regular meals. The tool also provided home-based remedies for common digestive problems and listed signs of fiber deficiency to promote self-awareness.

A bilingual take-away brochure was given to reinforce learning. It summarized fiber benefits, recommended intakes, food sources, and simple lifestyle tips. Designed to be visually clear and culturally appropriate, the brochure served as a practical guide to support long-term behavior change and improved digestive health in the Kandivali population.

4.9 Method of Data Collection -

- The research was conducted at Kandivali region, Mumbai.
- The general population who met the specified criteria were enrolled in the study.

- The investigator used a pre-intervention questionnaire to collect information on anthropometric measurements, dietary fiber intake and GI discomfort
- Using an educational tool, study participants got an educational intervention.
- A takeout brochure with information on the health advantages of Dietary fiber was also given to participants.
- SPSS was used to code and analyze all of the gathered data.
- To reach a decision, the results and outcomes were discussed.
- The final report was prepared.

4.10 Method of Data Collection Relevant To the Objective -

After the educational intervention, data were collected using a structured post-educational questionnaire that included anthropometric measurements, dietary patterns, and specifically dietary fiber intake. The questionnaire aimed to evaluate changes in participants' knowledge, awareness, and fiber consumption behavior following the program.

Participants received education through a bilingual (English and Hindi) educational tool explaining the types, sources, recommended intake, and health benefits of dietary fiber, along with practical ways to include it in daily meals. A take-home brochure was also distributed to reinforce learning, featuring local high-fiber foods, symptoms of fiber deficiency, home remedies for digestive issues, and simple fiber-rich recipes.

The follow-up assessment measured changes in dietary habits, gastrointestinal symptoms, and overall health improvements, effectively determining the impact of the educational intervention on digestive health in the Kandivali population.

4.11 Data Analysis Plan and Method -

Data collected during the study were compiled in Microsoft Excel (.xlsx) and checked for completeness and accuracy. Statistical analysis was performed using SPSS and Stata (v13.1, StataCorp, USA). Only data from participants meeting inclusion criteria were analyzed, and missing data were treated as missing without imputation.

Descriptive statistics were used to assess dietary fiber intake and the prevalence of gastrointestinal (GI) issues such as constipation, bloating, and indigestion. Fiber intake was reported as mean ± standard deviation (SD), along with median and range values. GI symptom prevalence was expressed as frequency and percentage.

Spearman's rank correlation coefficient evaluated relationships between fiber intake and severity of GI symptoms. To assess changes in GI symptoms post-intervention, the Wilcoxon Signed-Rank Test was applied, with results presented as median and interquartile range (IQR). A p-value < 0.05 was considered statistically significant, indicating meaningful improvements in digestive health following the educational program.

5. RESULTS

5.1 Demographic Data

	No.	*%*
Age Gr. (yrs.)		
• 18-30 yrs	52	51.0%
• 31-40 yrs	30	29.4%
• 41-50 yrs	20	19.6%
Gender		
• Male	51	50.0%
• Female	51	50.0%

No.: Number of counts; yrs: years.

Table 5.1 : Demographic characteristics of participants (n=102)

In terms of age distribution , the majority of participants (51.0%) belonged to the 18–30 years age group (n = 52). This was followed by 29.4% in the 31–40 years age group (n = 30), and 19.6% were aged between 41–50 years (n = 20). With respect to gender, the participant pool was equally divided, with 51 males (50.0%) and 51 females (50.0%). This balanced representation allowed for an unbiased evaluation of dietary fiber intake and gastrointestinal (GI) health outcomes across different age and gender groups.

5.2 Pre Test Intervention -

Primary Objective:

A) Evaluate the current levels of dietary Fiber intake and identify the prevalence and types of gastrointestinal issues

	No.	%
GI Discomfort		
• No	83	81.4%
• Yes	19	18.6%
GI Discomfort Details		
• Acidity	5	4.9%
• Bloating	2	2.0%
• Gas	2	2.0%
• Constipation	9	8.8%
• Even consuming less amount of food, I feel full	1	1.0%
• Not to tell	1	1.0%
• Stomach pain	1	1.0%
Medication Usage		
• Laxatives	7	6.9%
• Laxatives, Prokinetics, Anti-spasm., Anti-diarrheal agents	1	1.0%
• Other	3	2.9%
• None of the above	91	89.2%
Other Medications		
• Cremaffin	2	2.0%
• Duphalac	1	1.0%

No.: Number of counts.

Table 5. 2 : Gastrointestinal discomfort and medication usage of participants in pre-test intervention (n=102)

Before the intervention, **81.4% (n = 83)** had no GI issues, while **18.6% (n = 19)** reported problems — mainly **constipation (8.8%)**, **acidity (4.9%)**, **bloating (2.0%)**, and **gas (2.0%)**. About **6.9%** used laxatives, **1.0%** took other GI medicines, and **89.2% (n = 91)** reported no medication use.

B) Dietary Fibre Intervention

	No.	%
Dietary Fibre intake		
Fruit and Vegetable Intake Frequency		
• Never	2	2.0%
• Rarely	22	21.6%
• Sometimes	52	51.0%
• Often	19	18.6%
• Always	7	6.9%
Daily Vegetable Servings		
• 0	2	2.0%
• 1 to 2	82	80.4%
• 3 to 4	16	15.7%
• 5 or more	2	2.0%
Whole Grains Consumption Frequency		
• Never	4	3.9%
• Rarely	10	9.8%
• Sometimes	23	22.5%
• Often	41	40.2%
• Always	24	23.5%
Daily Whole Grains Servings		
• 0	6	5.9%
• 1 to 2	74	72.5%
• 3 to 4	21	20.6%
• 5 or more	1	1.0%
Beans, Lentils, and Legumes Consumption Frequency		
• Never	5	4.9%
• Rarely	21	20.6%
• Sometimes	65	63.7%
• Often	9	8.8%
• Always	2	2.0%
Fiber-Rich Snacks Consumption		
• Never	3	2.9%
• Rarely	23	22.5%
• Sometimes	54	52.9%
• Often	14	13.7%
• Always	8	7.8%
Refined Grains Consumption Frequency		
• Never	14	13.7%
• Rarely	20	19.6%
• Sometimes	38	37.3%
• Often	19	18.6%
• Always	11	10.8%
Daily Fruit Servings		
• 0 time	14	13.7%
• 1 time	70	68.6%
• 2 times	17	16.7%
• 3 or more	1	1.0%
Familiarity with Recommended Fiber Intake		
• Very familiar	7	6.9%
• Somewhat familiar	38	37.3%
• Not familiar at all	57	55.9%
• Other	0	0.0%

No.: Number of counts.

Table 5. 3 : Dietary Fibre intake Questionnaire of participants in pre-test intervention (n=102)

Before the intervention, dietary fiber intake among the 102 participants was assessed using a structured questionnaire

C) GI Symptoms

	No.	%
Gastric Function		
Indigestion or Food Repeating After Eating		
• No/Rarely	67	65.7%
• Occasionally	17	16.7%
• Often	16	15.7%
• Frequently	2	2.0%
Excessive Burping or Bloating After Meals		
• No/Rarely	41	40.2%
• Occasionally	31	30.4%
• Often	30	29.4%
• Frequently	0	0.0%
Stomach Cramp During or After Eating		
• No/Rarely	84	82.4%
• Occasionally	15	14.7%
• Often	3	2.9%
• Frequently	0	0.0%
Feeling Full Immediately After Small Amounts of Food		
• No/Rarely	38	37.3%
• Occasionally	38	37.3%
• Often	22	21.6%
• Frequently	4	3.9%
Skipping Meals Due to Lack of Appetite		
• No/Rarely	33	32.4%
• Occasionally	42	41.2%
• Often	23	22.5%
• Frequently	4	3.9%

No.: Number of counts.

Table 5.4: GI health questionnaire related gastric function of patients in pre-test intervention (n=102)

	No.	%
GI inflammation		
Stomach Pain, Burning, or Aching (1-4 hrs after Eating)		
• No/Rarely	80	78.4%
• Occasionally	14	13.7%
• Often	8	7.8%
• Frequently	0	0.0%
Stomach Pain Relieved by Food or Beverages		
• No/Rarely	60	58.8%
• Occasionally	21	20.6%
• Often	21	20.6%
• Frequently	0	0.0%
Nausea from Rough-Textured or Dry Foods		
• No/Rarely	84	82.4%
• Occasionally	16	15.7%
• Often	2	2.0%
• Frequently	0	0.0%
Abdominal Pain When Lying Down (Relieved When Upright)		
• No/Rarely	88	86.3%
• Occasionally	9	8.8%
• Often	5	4.9%
• Frequently	0	0.0%
Feeling of Food Remaining in Stomach for Hours		
• No/Rarely	73	71.6%
• Occasionally	21	20.6%
• Often	8	7.8%
• Frequently	0	0.0%
Difficulty or Pain When Swallowing		
• No/Rarely	96	94.1%
• Occasionally	4	3.9%
• Often	2	2.0%
• Frequently	0	0.0%

No.: Number of counts.

Table 5.5: GI health questionnaire related GI inflammation of participants in pre-test intervention (n=102)

	No.	%
Indigestion, Fullness, or Abdominal Tension		
• No/Rarely	77	75.5%
• Occasionally	15	14.7%
• Often	10	9.8%
• Frequently	0	0.0%
Gas or Bloating After Specific Foods or Drinks		
• No/Rarely	48	47.1%
• Occasionally	23	22.5%
• Often	31	30.4%
• Frequently	0	0.0%
Stools with Embarrassing Odor or Sticky Consistency		
• No/Rarely	55	53.9%
• Occasionally	33	32.4%
• Often	14	13.7%
• Frequently	0	0.0%
Three or More Large Bowel Movements		
• No/Rarely	62	60.8%
• Occasionally	35	34.3%
• Often	5	4.9%
• Frequently	0	0.0%
Frequent Loose or Watery Stools (Diarrhea)		
• No/Rarely	85	83.3%
• Occasionally	13	12.7%
• Often	4	3.9%
• Frequently	0	0.0%
Bowel Movements Within an Hour of Eating		
• No/Rarely	70	68.6%
• Occasionally	27	26.5%
• Often	5	4.9%
• Frequently	0	0.0%

No.: Number of counts.

Table 5.6 : GI health questionnaire related Small Intestine & Pancreas of participants in pre-test intervention

	No.	%
Lower Abdominal Discomfort, Pain, or Cramps		
• No/Rarely	73	71.6%
• Occasionally	20	19.6%
• Often	9	8.8%
• Frequently	0	0.0%
Bloating, Pain, or Gas After Eating Raw Fruits & Vegetables		
• No/Rarely	35	34.3%
• Occasionally	14	13.7%
• Often	53	52.0%
• Frequently	0	0.0%
Constipation		
• No/Rarely	25	24.5%
• Occasionally	40	39.2%
• Often	36	35.3%
• Frequently	1	1.0%
Discomfort or Straining During Bowel Movements		
• No/Rarely	59	57.8%
• Occasionally	33	32.4%
• Often	9	8.8%
• Frequently	1	1.0%
Small, Hard, and Dry Stool		
• No/Rarely	64	62.7%
• Occasionally	32	31.4%
• Often	5	4.9%
• Frequently	1	1.0%
Aching in Lower Back After Bowel Movement		
• No/Rarely	79	77.5%
• Occasionally	16	15.7%
• Often	7	6.9%
• Frequently	0	0.0%
Continual Urge to Have a Bowel Movement (Even After Going)		
• No/Rarely	85	83.3%
• Occasionally	14	13.7%
• Often	3	2.9%
• Frequently	0	0.0%

No.: Number of counts.

Table 5.7: GI health questionnaire related Colon of patients in pre-test intervention (n=102)

In the above table Gastrointestinal (GI) symptoms related to gastric function were assessed in the pre-test intervention among 102 participants.

Secondary Objective :

Investigate the relationship between Fiber intake and gastrointestinal health outcomes

		Fruit and Vegetable Intake Frequency	Daily Vegetable Servings	Whole Grains Consumption Frequency	Daily Whole Grains Servings	Beans, Lentils, and Legumes Consumption Frequency	Fiber-Rich Snacks Consumption	Refined Grains Consumption Frequency	Daily Fruit Servings	Familiarity with Recommended Fiber Intake
Gastric Function										
Indigestion or Food Repeating After Eating	r	-0.182	0.137	-0.043	0.004	-0.088	-0.354	-0.025	-0.032	-0.023
	p	0.104	0.171	0.668	0.971	0.422	0.000	0.802	0.748	0.817
Excessive Burping or Bloating After Meals	r	-0.149	-0.118	-0.069	0.085	-0.047	-0.168	-0.051	-0.069	0.119
	p	0.134	0.239	0.491	0.395	0.641	0.091	0.610	0.489	0.235
Stomach Cramp During or After Eating	r	-0.135	-0.043	0.058	-0.092	-0.189	-0.242	-0.024	0.101	-0.133
	p	0.175	0.669	0.562	0.360	0.058	0.014	0.808	0.312	0.184
Feeling Full Immediately After Small Amounts of Food	r	-0.261	-0.088	-0.250	-0.026	-0.031	-0.065	0.081	-0.085	-0.154
	p	0.008	0.377	0.011	0.795	0.754	0.534	0.416	0.396	0.178
Skipping Meals Due to Lack of Appetite	r	-0.223	-0.056	-0.276	-0.148	-0.038	0.039	0.114	-0.065	-0.117
	p	0.024	0.578	0.005	0.137	0.763	0.851	0.254	0.517	0.243
Gastric Function Total Score	r	-0.271	-0.064	-0.214	-0.053	-0.045	-0.214	0.023	-0.131	-0.039
	p	0.006	0.522	0.031	0.596	0.651	0.031	0.815	0.190	0.694
Gastric Function Total Score Priority	r	-0.239	-0.018	-0.142	-0.049	0.074	-0.194	-0.008	-0.121	-0.036
	p	0.015	0.856	0.154	0.626	0.461	0.051	0.937	0.225	0.722
GI Inflammation										
Stomach Pain, Burning, or Aching (1-4 hrs after Eating)	r	0.117	0.104	-0.185	-0.122	-0.296	-0.110	0.243	0.129	-0.037
	p	0.242	0.299	0.062	0.222	0.003	0.273	0.014	0.196	0.712
Stomach Pain Relieved by Food or Beverages	r	-0.190	-0.046	-0.059	-0.016	-0.178	-0.229	0.073	-0.182	0.036
	p	0.056	0.644	0.372	0.870	0.074	0.021	0.464	0.330	0.720
Nausea from Rough-Textured or Dry Foods	r	-0.138	-0.041	-0.022	-0.108	-0.213	-0.107	0.046	-0.037	-0.262
	p	0.167	0.679	0.824	0.316	0.031	0.283	0.648	0.713	0.008
Abdominal Pain When Lying Down (Relieved When Upright)	r	0.097	0.039	-0.262	-0.173	-0.254	-0.164	0.005	-0.014	-0.238
	p	0.330	0.847	0.008	0.081	0.010	0.100	0.956	0.887	0.016
Feeling of Food Remaining in Stomach for Hours	r	-0.153	0.044	-0.209	-0.189	-0.158	-0.163	0.093	-0.033	-0.307
	p	0.124	0.659	0.035	0.057	0.132	0.103	0.354	0.099	0.002
Difficulty or Pain When Swallowing	r	-0.147	-0.156	-0.253	-0.228	-0.396	-0.078	0.007	-0.154	-0.079
	p	0.140	0.118	0.010	0.026	0.000	0.437	0.946	0.123	0.433
GI Inflammation Total Score	r	-0.189	0.012	-0.181	-0.138	-0.316	-0.247	0.175	-0.079	-0.127
	p	0.274	0.903	0.069	0.165	0.000	0.002	0.078	0.428	0.205
GI Inflammation Total Score Priority	r	-0.092	0.028	-0.133	-0.107	-0.263	-0.139	0.236	-0.004	-0.114
	p	0.358	0.782	0.184	0.286	0.008	0.160	0.017	0.899	0.256
Small Intestine & Pancreas										
Indigestion, Fullness, or Abdominal Tension (24 hrs after Eating)	r	-0.095	0.029	-0.089	-0.134	-0.250	-0.105	0.134	0.079	-0.204
	p	0.365	0.778	0.374	0.180	0.011	0.304	0.252	0.429	0.004
Gas or Bloating After Specific Foods or Drinks	r	-0.106	0.180	0.016	-0.039	-0.130	-0.118	0.033	-0.016	0.062
	p	0.288	0.119	0.874	0.698	0.194	0.238	0.739	0.870	0.528
Stools with Embarrassing Odor or Sticky Consistency	r	-0.098	0.054	0.024	-0.039	-0.165	-0.300	0.127	0.027	-0.101
	p	0.379	0.591	0.811	0.699	0.098	0.002	0.202	0.785	0.314
Three or More Large Bowel Movements	r	-0.037	-0.061	-0.053	-0.181	-0.137	-0.262	0.034	0.132	0.002
	p	0.710	0.544	0.596	0.069	0.169	0.008	0.731	0.187	0.983
Frequent Loose or Watery Stools (Diarrhea)	r	-0.007	-0.024	-0.229	-0.120	-0.146	-0.267	-0.162	0.021	-0.308
	p	0.208	0.811	0.020	0.229	0.144	0.007	0.104	0.831	0.002
Bowel Movements Within an Hour of Eating	r	-0.069	-0.130	0.053	0.070	-0.190	-0.189	-0.080	-0.004	0.043
	p	0.489	0.173	0.595	0.485	0.133	0.057	0.381	0.405	0.665
Small Intestine & Pancreas Total Score	r	-0.096	0.085	0.008	-0.054	-0.215	-0.300	0.090	0.052	-0.068
	p	0.337	0.399	0.935	0.587	0.030	0.002	0.370	0.610	0.548
Small Intestine & Pancreas Total Score Priority	r	-0.107	0.024	-0.020	0.025	-0.118	-0.216	0.087	-0.086	-0.038
	p	0.861	0.813	0.844	0.800	0.239	0.029	0.382	0.388	0.708
Colon										
Lower Abdominal Discomfort, Pain, or Cramps	r	-0.042	-0.120	-0.142	-0.044	-0.204	-0.228	-0.032	-0.164	-0.041
	p	0.678	0.285	0.156	0.655	0.040	0.021	0.988	0.099	0.683
Bloating, Pain, or Gas After Eating Raw Fruits & Vegetables	r	-0.168	-0.282	-0.061	0.087	-0.013	-0.129	-0.087	0.113	0.296
	p	0.092	0.042	0.544	0.387	0.913	0.195	0.942	0.258	0.003
Constipation	r	-0.141	-0.135	-0.041	-0.135	-0.052	-0.298	0.013	-0.092	0.108
	p	0.157	0.177	0.688	0.178	0.604	0.002	0.896	0.359	0.313
Discomfort or Straining During Bowel Movements	r	-0.260	-0.113	0.074	-0.043	-0.213	-0.193	-0.060	-0.241	0.002
	p	0.008	0.256	0.459	0.671	0.032	0.052	0.548	0.015	0.984
Small, Hard, and Dry Stool	r	-0.155	0.063	0.001	-0.064	-0.181	-0.285	-0.046	-0.106	-0.136
	p	0.119	0.532	0.995	0.522	0.069	0.004	0.644	0.288	0.174
Aching in Lower Back After Bowel Movement	r	-0.116	0.177	0.010	-0.036	-0.229	-0.023	-0.151	-0.115	-0.153
	p	0.246	0.075	0.918	0.719	0.021	0.820	0.131	0.248	0.191
Continual Urge to Have a Bowel Movement (Even After Going)	r	-0.144	-0.034	-0.145	-0.137	-0.235	-0.134	-0.074	-0.219	-0.178
	p	0.148	0.730	0.147	0.169	0.018	0.179	0.461	0.027	0.077
Colon Total Score	r	-0.178	-0.082	-0.003	-0.081	-0.177	-0.276	-0.041	-0.182	0.107
	p	0.072	0.360	0.317	0.541	0.078	0.005	0.683	0.067	0.285
Colon Total Score Priority	r	-0.159	-0.103	-0.066	-0.086	-0.148	-0.269	-0.041	-0.128	0.071
	p	0.110	0.304	0.507	0.389	0.138	0.008	0.680	0.199	0.475

r: Correlation, p: Pearson's correlation

Table.5.8: Correlation between Fiber intake and gastrointestinal health outcomes of participants in pre-test intervention (n=102)

The correlation analysis highlighted that higher intake of fiber-rich snacks and legumes was significantly associated with reduced gastric symptoms like indigestion ($r = -0.354$, $p = 0.000$) and poor appetite ($r = -0.223$, $p = 0.024$). Fruits and vegetables also showed moderate inverse correlations with satiety-related discomfort.

For GI inflammation, legumes had strong negative correlations with symptoms such as stomach pain ($r = -0.296$, $p = 0.003$) and swallowing difficulty ($r = -0.396$, $p = 0.000$). Whole grains and fiber familiarity were also linked to improved outcomes.

Within the small intestine and colon, higher legume and fiber-rich snack consumption correlated with fewer symptoms like watery stools, abdominal pain, and constipation ($r = -0.250$ to -0.364, $p < 0.05$). Interestingly, bloating from raw produce was linked to higher fruit intake, possibly due to Fermentable Oligosaccharides, Disaccharides, Monosaccharides And Polyols (FODMAP).

In summary, increased intake of plant-based fiber particularly from legumes, whole grains, fruits, and snacks is associated with better GI health and reduced inflammation.

5.3 Post test Intervention

Primary Objective -

A) Evaluate the current levels of dietary Fiber intake and identify the prevalence and types of gastrointestinal issues

	No.	%
GI Discomfort		
• No	73	91.3%
• Yes	7	8.8%
GI Discomfort Details		
• Acidity	3	3.8%
• bloating	1	1.3%
• Constipation	1	1.3%
• Gas	2	2.5%
• Stomach pain	1	1.3%
Medication Usage		
• Laxatives	0	0.0%
• Laxatives, Prokinetics, Anti-spasm., Anti-diarrheal agents	0	0.0%
• Other	0	0.0%
• None of the above	80	100.0%

No.: Number of counts.

Table.5.9: Gastrointestinal discomfort and medication usage of participants in post-test intervention

Following the intervention , 91.3% of participants reported no gastrointestinal (GI) discomfort, while only 8.8%experienced symptoms. Reported issues included acidity (3.8%), gas (2.5%), bloating, constipation, and stomach pain(each 1.3%). Notably, none of the participants reported using any GI medications, including laxatives, prokinetics, or anti-diarrheal agents, indicating a possible improvement in symptoms through non-pharmacological means—likely due to dietary intervention.

	No.	%
Dietary Fibre intake		
Fruit and Vegetable Intake Frequency		
• Never	0	0.0%
• Rarely	3	3.8%
• Sometimes	32	40.0%
• Often	37	46.3%
• Always	8	10.0%
Daily Vegetable Servings		
• 0	0	0.0%
• 1 to 2	68	85.0%
• 3 to 4	11	13.8%
• 5 or more	1	1.3%
Whole Grains Consumption Frequency		
• Never	0	0.0%
• Rarely	8	10.0%
• Sometimes	16	20.0%
• Often	38	47.5%
• Always	18	22.5%
Daily Whole Grains Servings		
• 0	0	0.0%
• 1 to 2	64	80.0%
• 3 to 4	16	20.0%
• 5 or more	0	0.0%
Beans, Lentils, and Legumes Consumption Frequency		
• Never	0	0.0%
• Rarely	12	15.0%
• Sometimes	54	67.5%
• Often	12	15.0%
• Always	2	2.5%
Fiber-Rich Snacks Consumption		
• Never	0	0.0%
• Rarely	4	5.0%
• Sometimes	21	26.3%
• Often	40	50.0%
• Always	15	18.8%
Refined Grains Consumption Frequency		
• Never	7	8.8%
• Rarely	19	23.8%
• Sometimes	35	43.8%
• Often	11	13.8%
• Always	8	10.0%
Daily Fruit Servings		
• 0 time	60	75.0%
• 1 time	19	23.8%
• 2 times	0	0.0%
• 3 or more	1	1.3%
Familiarity with Recommended Fiber Intake		
• Very familiar	79	98.8%
• Somewhat familiar	0	0.0%
• Not familiar at all	1	1.3%
• Other	0	0.0%

No.: Number of counts.

Table 5.10: Dietary Fibre intake Questionnaire of patients in post-test intervention

After the intervention, fruit and vegetable intake improved — 46.3% often and 10.0% always consumed them. Most (85.0%) had 1–2 servings of vegetables daily. Whole grain intake was high, with 47.5% often and 22.5% always consuming them. Legume intake was moderate (67.5% sometimes), and fiber-rich snacks were eaten often by 50.0%. Refined grain use decreased, and fiber awareness rose sharply, with 98.8% very familiar with recommendations.

B) GI Symptoms

	No.	%
Gastric Function		
Indigestion or Food Repeating After Eating		
• No/Rarely	55	68.8%
• Occasionally	16	20.0%
• Often	8	10.0%
• Frequently	1	1.3%
Excessive Burping or Bloating After Meals		
• No/Rarely	41	51.2%
• Occasionally	26	32.5%
• Often	13	16.3%
• Frequently	0	0.0%
Stomach Cramp During or After Eating		
• No/Rarely	72	90.0%
• Occasionally	7	8.8%
• Often	1	1.3%
• Frequently	0	0.0%
Feeling Full Immediately After Small Amounts of Food		
• No/Rarely	32	40.0%
• Occasionally	28	35.0%
• Often	17	21.3%
• Frequently	3	3.8%
Skipping Meals Due to Lack of Appetite		
• No/Rarely	45	56.3%
• Occasionally	28	35.0%
• Often	7	8.8%
• Frequently	0	0.0%

No.: Number of counts.

Table.5.11: GI health questionnaire related gastric function of patients in post-test intervention

In the post-test group (n = 80), improvements in gastric function symptoms were observed.

	No.	%
GI inflammation		
Stomach Pain, Burning, or Aching (1-4 hrs after Eating)		
• No/Rarely	64	80.0%
• Occasionally	10	12.5%
• Often	6	7.5%
• Frequently	0	0.0%
Stomach Pain Relieved by Food or Beverages		
• No/Rarely	51	63.7%
• Occasionally	18	22.5%
• Often	11	13.8%
• Frequently	0	0.0%
Nausea from Rough-Textured or Dry Foods		
• No/Rarely	68	85.0%
• Occasionally	12	15.0%
• Often	0	0.0%
• Frequently	0	0.0%
Abdominal Pain When Lying Down (Relieved When Upright)		
• No/Rarely	71	88.8%
• Occasionally	6	7.5%
• Often	3	3.8%
• Frequently	0	0.0%
Feeling of Food Remaining in Stomach for Hours		
• No/Rarely	58	72.5%
• Occasionally	17	21.3%
• Often	5	6.3%
• Frequently	0	0.0%
Difficulty or Pain When Swallowing		
• No/Rarely	79	98.8%
• Occasionally	1	1.3%
• Often	0	0.0%
• Frequently	0	0.0%

No.: Number of counts.

Table.5.12: GI health questionnaire related GI inflammation of participants in post-test intervention

In the post-test group (n = 80), the prevalence of gastrointestinal inflammation-related symptoms was generally low.

	No.	%
Indigestion, Fullness, or Abdominal Tension		
• No/Rarely	63	78.8%
• Occasionally	11	13.8%
• Often	6	7.5%
• Frequently	0	0.0%
Gas or Bloating After Specific Foods or Drinks		
• No/Rarely	39	48.8%
• Occasionally	22	27.5%
• Often	18	22.5%
• Frequently	1	1.3%
Stools with Embarrassing Odor or Sticky Consistency		
• No/Rarely	52	65.0%
• Occasionally	26	32.5%
• Often	2	2.5%
• Frequently	0	0.0%
Three or More Large Bowel Movements		
• No/Rarely	60	75.0%
• Occasionally	16	20.0%
• Often	4	5.0%
• Frequently	0	0.0%
Frequent Loose or Watery Stools (Diarrhea)		
• No/Rarely	71	88.8%
• Occasionally	8	10.0%
• Often	1	1.3%
• Frequently	0	0.0%
Bowel Movements Within an Hour of Eating		
• No/Rarely	63	78.8%
• Occasionally	15	18.8%
• Often	2	2.5%
• Frequently	0	0.0%

No.: Number of counts.

Table.5.13: GI health questionnaire related Small Intestine & Pancreas of participants in post- test intervention

Among post-test participants (n = 80), symptoms related to small intestine and pancreatic function showed generally low occurrence.

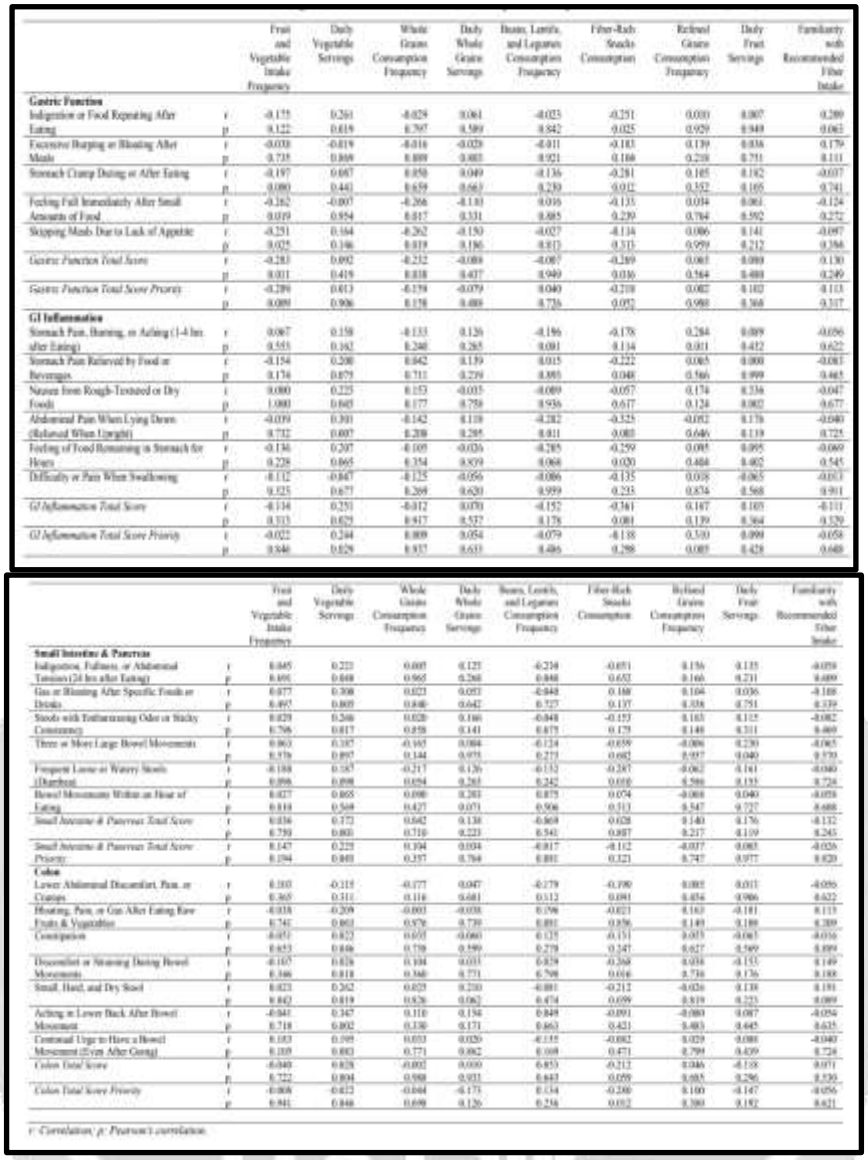
	No.	%
Lower Abdominal Discomfort, Pain, or Cramps		
• No/Rarely	64	80.0%
• Occasionally	12	15.0%
• Often	4	5.0%
• Frequently	0	0.0%
Bloating, Pain, or Gas After Eating Raw Fruits & Vegetables		
• No/Rarely	22	27.5%
• Occasionally	22	27.5%
• Often	36	45.0%
• Frequently	0	0.0%
Constipation		
• No/Rarely	17	21.3%
• Occasionally	40	50.0%
• Often	22	27.5%
• Frequently	1	1.3%
Discomfort or Straining During Bowel Movements		
• No/Rarely	54	67.5%
• Occasionally	22	27.5%
• Often	3	3.8%
• Frequently	1	1.3%
Small, Hard, and Dry Stool		
• No/Rarely	60	75.0%
• Occasionally	19	23.8%
• Often	0	0.0%
• Frequently	1	1.3%
Aching in Lower Back After Bowel Movement		
• No/Rarely	65	81.3%
• Occasionally	11	13.8%
• Often	4	5.0%
• Frequently	0	0.0%
Continual Urge to Have a Bowel Movement (Even After Going)		
• No/Rarely	71	88.8%
• Occasionally	9	11.3%
• Often	0	0.0%
• Frequently	0	0.0%

No.: Number of counts.

Table.5.14: GI health questionnaire related Colon of participants in post-test intervention

In the post-test group (n = 80), colon-related gastrointestinal symptoms showed a marked improvement.

Secondary Objectives -



		Fruit and Vegetable Intake Frequency	Daily Vegetable Servings	Whole Grains Consumption Frequency	Daily Whole Grains Servings	Beans, Lentils, and Legumes Consumption Frequency	Fiber-Rich Snacks Consumption	Refined Grains Consumption Frequency	Daily Fruit Servings	Familiarity with Recommended Fiber Intake
Gastric Function										
Indigestion or Food Repeating After Eating	r	-0.175	0.261	-0.029	0.061	-0.025	-0.251	0.030	0.007	0.289
	p	0.122	0.019	0.797	0.589	0.842	0.025	0.929	0.949	0.063
Excessive Burping or Bloating After Meals	r	-0.030	-0.019	-0.016	-0.029	-0.011	-0.183	0.139	0.036	0.179
	p	0.735	0.869	0.889	0.803	0.921	0.166	0.220	0.751	0.111
Stomach Cramp During or After Eating	r	-0.197	0.087	0.050	0.049	-0.136	-0.281	0.105	0.182	-0.037
	p	0.080	0.441	0.659	0.663	0.230	0.012	0.352	0.105	0.741
Feeling Full Immediately After Small Amounts of Food	r	-0.262	-0.007	-0.266	-0.130	0.016	-0.133	0.034	0.061	-0.124
	p	0.019	0.954	0.017	0.331	0.885	0.239	0.764	0.592	0.272
Skipping Meals Due to Lack of Appetite	r	-0.251	0.164	-0.262	-0.150	-0.027	-0.134	0.086	0.141	-0.097
	p	0.025	0.196	0.019	0.186	0.813	0.235	0.459	0.212	0.394
Gastric Function Total Score	r	-0.283	0.092	-0.232	-0.088	-0.087	-0.289	0.065	0.089	0.130
	p	0.011	0.419	0.038	0.437	0.949	0.010	0.564	0.480	0.249
Gastric Function Total Score Priority	r	-0.289	0.013	-0.159	-0.079	0.040	-0.270	0.002	0.102	0.113
	p	0.009	0.906	0.158	0.488	0.726	0.052	0.980	0.368	0.317
GI Inflammation										
Stomach Pain, Burning, or Aching (1-4 hrs after Eating)	r	0.067	0.158	-0.133	0.126	-0.196	-0.176	0.284	0.089	-0.056
	p	0.553	0.162	0.240	0.265	0.081	0.134	0.011	0.432	0.622
Stomach Pain Relieved by Food or Beverages	r	-0.154	0.200	0.042	0.139	0.015	-0.222	0.065	0.000	-0.083
	p	0.174	0.079	0.711	0.219	0.895	0.048	0.566	0.999	0.465
Nausea from Rough-Textured or Dry Foods	r	0.000	0.225	0.153	-0.035	-0.089	-0.057	0.174	0.336	-0.047
	p	1.000	0.045	0.177	0.758	0.936	0.617	0.124	0.002	0.677
Abdominal Pain When Lying Down (Relieved When Upright)	r	-0.059	0.301	-0.142	0.110	-0.282	-0.325	-0.052	0.176	-0.040
	p	0.732	0.007	0.208	0.295	0.011	0.003	0.646	0.119	0.725
Feeling of Food Remaining in Stomach for Hours	r	-0.136	0.207	-0.105	-0.026	-0.285	-0.259	0.095	0.095	-0.069
	p	0.228	0.065	0.354	0.819	0.068	0.020	0.404	0.402	0.545
Difficulty or Pain When Swallowing	r	-0.112	-0.047	-0.125	-0.056	-0.086	-0.135	0.018	-0.065	-0.013
	p	0.325	0.677	0.269	0.620	0.959	0.233	0.874	0.568	0.911
GI Inflammation Total Score	r	-0.134	0.251	-0.012	0.070	-0.152	-0.361	0.167	0.105	-0.111
	p	0.313	0.025	0.917	0.537	0.178	0.001	0.139	0.364	0.329
GI Inflammation Total Score Priority	r	-0.022	0.244	0.009	0.054	-0.079	-0.138	0.310	0.099	-0.058
	p	0.846	0.029	0.937	0.633	0.486	0.298	0.005	0.428	0.608

		Fruit and Vegetable Intake Frequency	Daily Vegetable Servings	Whole Grains Consumption Frequency	Daily Whole Grains Servings	Beans, Lentils, and Legumes Consumption Frequency	Fiber-Rich Snacks Consumption	Refined Grains Consumption Frequency	Daily Fruit Servings	Familiarity with Recommended Fiber Intake
Small Intestine & Pancreas										
Indigestion, Fullness, or Abdominal Tension (24 hrs after Eating)	r	0.045	0.221	0.005	0.125	-0.234	-0.051	0.156	0.135	-0.059
	p	0.691	0.048	0.965	0.268	0.848	0.652	0.166	0.231	0.609
Gas or Bloating After Specific Foods or Drinks	r	0.077	0.308	0.023	0.053	-0.048	0.108	0.104	0.036	-0.108
	p	0.497	0.005	0.840	0.642	0.727	0.337	0.358	0.751	0.339
Stools with Embarrassing Odor or Sticky Consistency	r	0.029	0.266	0.020	0.166	-0.048	-0.153	0.163	0.115	-0.082
	p	0.796	0.017	0.858	0.141	0.675	0.179	0.148	0.311	0.469
Three or More Large Bowel Movements	r	0.063	0.187	-0.165	0.084	-0.124	-0.059	-0.006	0.230	-0.065
	p	0.578	0.097	0.144	0.458	0.273	0.602	0.957	0.040	0.570
Frequent Loose or Watery Stools (Diarrhea)	r	-0.188	0.187	-0.217	0.126	-0.132	-0.247	-0.062	0.161	-0.040
	p	0.096	0.098	0.054	0.265	0.242	0.010	0.586	0.153	0.724
Bowel Movements Within an Hour of Eating	r	0.027	0.065	0.090	0.203	0.075	0.074	-0.008	0.040	-0.058
	p	0.810	0.569	0.427	0.071	0.506	0.513	0.947	0.727	0.608
Small Intestine & Pancreas Total Score	r	0.036	0.172	0.042	0.138	-0.069	0.028	0.140	0.176	-0.132
	p	0.750	0.003	0.710	0.223	0.541	0.807	0.217	0.119	0.245
Small Intestine & Pancreas Total Score Priority	r	0.147	0.229	0.194	0.034	-0.017	-0.112	-0.037	0.003	-0.026
	p	0.194	0.040	0.257	0.764	0.891	0.321	0.747	0.977	0.820
Colon										
Lower Abdominal Discomfort, Pain, or Cramps	r	0.103	-0.115	-0.177	0.047	-0.179	-0.190	0.085	0.013	-0.056
	p	0.365	0.311	0.116	0.681	0.112	0.091	0.454	0.906	0.622
Bloating, Pain, or Gas After Eating Raw Fruits & Vegetables	r	-0.038	-0.209	-0.003	-0.038	0.098	-0.021	0.163	-0.181	0.115
	p	0.741	0.063	0.978	0.739	0.391	0.856	0.149	0.189	0.309
Constipation	r	-0.051	0.022	0.035	-0.060	0.125	-0.151	0.073	-0.063	-0.016
	p	0.653	0.846	0.758	0.599	0.270	0.247	0.627	0.599	0.889
Discomfort or Straining During Bowel Movements	r	-0.107	0.026	0.104	0.031	0.029	-0.268	0.038	-0.153	0.149
	p	0.346	0.818	0.360	0.771	0.798	0.016	0.738	0.176	0.188
Small, Hard, and Dry Stool	r	0.023	0.262	0.025	0.230	-0.001	-0.212	-0.026	0.138	0.191
	p	0.842	0.019	0.826	0.062	0.474	0.059	0.819	0.223	0.089
Aching in Lower Back After Bowel Movement	r	-0.041	0.047	0.110	0.154	0.049	-0.091	-0.089	0.087	-0.056
	p	0.718	0.802	0.330	0.171	0.663	0.421	0.483	0.445	0.635
Continual Urge to Have a Bowel Movement (Even After Going)	r	0.103	0.095	0.033	0.020	-0.135	-0.082	0.029	0.088	-0.040
	p	0.369	0.403	0.771	0.862	0.169	0.471	0.799	0.439	0.728
Colon Total Score	r	-0.040	0.028	-0.002	0.000	0.053	-0.212	0.046	-0.138	0.071
	p	0.722	0.804	0.988	0.931	0.643	0.059	0.685	0.296	0.530
Colon Total Score Priority	r	-0.008	0.022	-0.044	-0.173	0.134	-0.200	0.100	-0.147	-0.056
	p	0.941	0.848	0.698	0.126	0.238	0.012	0.380	0.192	0.621

r: Correlation; p: Pearson's correlation

Table.5.15: Correlation between Fiber intake and gastrointestinal health outcomes of participants in pre-test intervention (n=80)

The correlation analysis (Table 5.15) between fiber intake and gastrointestinal health outcomes in the pre-treatment group (n=80) revealed several significant associations. Daily vegetable servings showed a moderate positive correlation with improved small intestine and pancreatic outcomes ($r = 0.372$, $p = 0.001$), and also correlated significantly with reductions in specific GI inflammation and colon symptoms. Fiber-rich snacks were negatively associated with both gastric and GI inflammation total scores ($r = -0.269$, $p = 0.016$ and $r = -0.361$, $p = 0.001$, respectively), suggesting a protective effect. Whole grains and legumes showed mixed and generally weaker correlations. Notably, higher fiber intake appeared to reduce symptoms like indigestion, fullness, and discomfort, though some parameters such as refined grain intake and familiarity with fiber recommendations showed limited or non-significant associations.

	Pre-Treatment (n=102)					Post Treatment (n=88)					Wilcoxon Test	
	Mean	SD	Median (Range)			Mean	SD	Median (Range)			Z	P
Dietary Fibre intake												
Fruit and Vegetable Intake Frequency	3.07	0.87	3.00	3.00	4.00	3.63	0.72	4.00	3.00	4.00	-5.636	<0.0001
Daily Vegetable Servings	2.18	0.48	2.00	2.00	2.00	2.16	0.40	2.00	2.00	2.00	-1.414	0.157
Whole Grains Consumption Frequency	3.70	1.06	4.00	3.00	4.00	3.83	0.90	4.00	3.00	4.00	-2.013	0.044
Daily Whole Grains Servings	2.17	0.53	2.00	2.00	2.00	2.20	0.40	2.00	2.00	2.00	.000	1.000
Beans, Lentils, and Legumes Consumption Frequency	2.82	0.74	3.00	2.00	3.00	3.05	0.63	3.00	3.00	3.00	-4.146	<0.0001
Fiber-Rich Snacks Consumption	3.01	0.90	3.00	2.00	3.00	3.83	0.79	4.00	3.00	4.00	-6.617	<0.0001
Refined Grains Consumption Frequency	2.93	1.17	3.00	2.00	4.00	2.93	1.06	3.00	2.00	3.00	-1.897	0.058
Daily Fruit Servings	2.06	0.59	2.00	2.00	2.00	1.28	0.53	1.00	1.00	1.75	-7.711	<0.0001
Familiarity with Recommended Fiber Intake	2.49	0.63	3.00	2.00	3.00	1.03	0.22	1.00	1.00	1.00	-7.723	<0.0001

SD: Standard deviation; p: Wilcoxon test.

Table.5.16: Changes from pre-test to post-test intervention in dietary fibre intake

In (Table 5.16) the intervention led to notable improvements in fiber-related dietary habits. Significant increases were observed in fruit and vegetable intake frequency (3.07 ± 0.87 to 3.63 ± 0.72, Z = -5.636, p < 0.0001), beans and legumes consumption(2.82 ± 0.74 to 3.05 ± 0.63, Z = -4.146, p < 0.0001), and fiber-rich snack intake (3.01 ± 0.90 to 3.83 ± 0.79, Z = -6.617, p < 0.0001). Whole grain frequency also improved slightly (3.70 ± 1.06 to 3.83 ± 0.90, p = 0.044). Most impressively, awareness of recommended fiber intake increased dramatically (2.49 ± 0.63 to 1.03 ± 0.22, Z = -7.723, p < 0.0001), reflecting strong knowledge gains.

These results underscore the effectiveness of the intervention in promoting healthier dietary behaviors and awareness

	Pre-Treatment (n=102)					Post Treatment (n=80)					Wilcoxon Test	
	Mean	SD	Percentiles			Mean	SD	Percentiles			Z	P
			50th	25th	75th			50th	25th	75th		
Gastric Function												
Indigestion or Food Repeating After Eating	0.95	1.75	0.00	0.00	1.00	0.70	1.46	0.00	0.00	1.00	-1.857	0.063
Excessive Burping or Bloating After Meals	1.48	1.69	1.00	0.00	4.00	0.98	1.41	0.00	0.00	1.00	-4.091	<0.0001
Stomach Cramp During or After Eating	0.26	0.74	0.00	0.00	0.00	0.14	0.52	0.00	0.00	0.00	-2.449	0.014
Feeling Full Immediately After Small Amounts of Food	1.55	1.99	1.00	0.00	4.00	1.50	1.99	1.00	0.00	3.25	-2.028	0.043
Skipping Meals Due to Lack of Appetite	1.63	1.98	1.00	0.00	4.00	0.70	1.13	0.00	0.00	1.00	-5.401	<0.0001
Gastric Function Total Score	5.87	5.14	5.00	2.00	9.00	4.01	3.98	3.00	1.00	5.75	-5.793	<0.0001
Gastric Function Total Score Priority	1.84	0.89	2.00	1.00	3.00	1.50	0.71	1.00	1.00	2.00	-4.704	<0.0001
GI Inflammation												
Stomach Pain, Burning, or Aching (1–4 hrs after Eating)	0.45	1.10	0.00	0.00	0.00	0.43	1.08	0.00	0.00	0.00	-1.633	0.102
Stomach Pain Relieved by Food or Beverages	1.03	1.57	0.00	0.00	1.00	0.78	1.36	0.00	0.00	1.00	-2.630	0.009
Nausea from Rough-Textured or Dry Foods	0.24	0.65	0.00	0.00	0.00	0.15	0.36	0.00	0.00	0.00	-1.890	0.059
Abdominal Pain When Lying Down (Relieved When Upright)	0.28	0.89	0.00	0.00	0.00	0.23	0.80	0.00	0.00	0.00	-1.000	0.317
Feeling of Food Remaining in Stomach for Hours	0.52	1.10	0.00	0.00	1.00	0.46	1.01	0.00	0.00	1.00	-1.098	0.272
Difficulty or Pain When Swallowing	0.12	0.59	0.00	0.00	0.00	0.01	0.11	0.00	0.00	0.00	-1.633	0.102
GI Inflammation Total Score	2.64	3.78	1.00	0.00	4.00	2.05	2.72	1.00	0.00	4.00	-3.646	<0.0001
GI Inflammation Total Score Priority	1.25	0.53	1.00	1.00	1.00	1.24	0.48	1.00	1.00	1.00	-.447	0.655
Indigestion, Fullness, or Abdominal Tension (24 hrs after Eating)	0.54	1.20	0.00	0.00	0.25	0.44	1.08	0.00	0.00	0.00	-1.000	0.317
Small Intestine & Pancreas												
Gas or Bloating After Specific Foods or Drinks	1.44	1.74	1.00	0.00	4.00	1.28	1.76	1.00	0.00	1.00	-1.438	0.150
Stools with Embarrassing Odor or Sticky Consistency	0.87	1.33	0.00	0.00	1.00	0.43	0.74	0.00	0.00	1.00	-3.256	0.001
Three or More Large Bowel Movements	0.54	0.92	0.00	0.00	1.00	0.40	0.92	0.00	0.00	0.75	-2.029	0.042
Frequent Loose or Watery Stools (Diarrhea)	0.28	0.83	0.00	0.00	0.00	0.15	0.53	0.00	0.00	0.00	-2.070	0.038
Bowel Movements Within an Hour of Eating	0.46	0.92	0.00	0.00	1.00	0.29	0.72	0.00	0.00	0.00	-2.456	0.014
Small Intestine & Pancreas Total Score	4.14	4.28	3.50	0.00	7.00	2.98	3.29	2.00	0.00	5.00	-4.283	<0.0001
Small Intestine & Pancreas Total Score Priority	1.17	0.40	1.00	1.00	1.00	1.06	0.29	1.00	1.00	1.00	-2.333	0.020
Colon												
Lower Abdominal Discomfort, Pain, or Cramps	0.55	1.15	0.00	0.00	1.00	0.35	0.92	0.00	0.00	0.00	-2.333	0.020
Bloating, Pain, or Gas After Eating Raw Fruits & Vegetables	2.22	1.89	4.00	0.00	4.00	2.08	1.79	1.00	0.00	4.00	-2.714	0.007
Constipation	1.88	1.78	1.00	0.75	4.00	1.70	1.69	1.00	1.00	4.00	-1.960	0.050
Discomfort or Straining During Bowel Movements	0.75	1.35	0.00	0.00	1.00	0.53	1.19	0.00	0.00	1.00	-2.804	0.005
Small, Hard, and Dry Stool	0.59	1.18	0.00	0.00	1.00	0.34	0.97	0.00	0.00	0.75	-2.640	0.008
Aching in Lower Back After Bowel Movement	0.43	1.04	0.00	0.00	0.00	0.34	0.91	0.00	0.00	0.00	-1.414	0.157
Continual Urge to Have a Bowel Movement (Even After Going)	0.25	0.74	0.00	0.00	0.00	0.11	0.32	0.00	0.00	0.00	-1.265	0.206
Colon Total Score	6.68	5.68	6.00	2.00	9.25	5.44	4.62	5.00	2.00	8.00	-4.323	<0.0001
Colon Total Score priority	1.96	0.80	2.00	1.00	3.00	1.21	0.44	1.00	1.00	1.00	-6.894	<0.0001

SD: Standard deviation; p: Wilcoxon test.

Table.5.17: Changes from pretest to post-test intervention in GI symptoms

In table (Table 5.17) the intervention yielded significant improvements in GI symptoms across multiple domains. Notably, gastric function scores decreased (5.87 ± 5.14 to 4.01 ± 3.98, Z = -5.793, p < 0.0001), along with a reduction in skipping meals due to lack of appetite (1.63 ± 1.98 to 0.70 ± 1.13, Z = -5.401, p < 0.0001). GI inflammation total scores improved (2.64 ± 3.78 to 2.05 ± 2.72, Z = -3.646, p < 0.0001), while symptoms like pain relieved by food also showed declines (Z = -2.630, p = 0.009). Improvements were evident in small intestine and pancreas function (total score: 4.14 ± 4.28 to 2.98 ± 3.29, Z = -4.283, p < 0.0001) and colon-related symptoms (6.68 ± 5.68 to 5.44 ± 4.62, Z = -4.323, p < 0.0001), including reductions in constipation and straining during bowel movements (p ≤ 0.05).

Overall, these results strongly support the clinical efficacy of the dietary intervention in alleviating GI discomfort and enhancing gut health.

	N	Mean	SD	Range	Min.	Max.
GI Symptoms Total Score						
Gastric Function -Pre	102	5.87	5.14	25.00	0.00	25.00
Gastric Function -Post	80	4.01	3.98	20.00	0.00	20.00
GI Inflammation -Pre	102	2.64	3.78	24.00	0.00	24.00
GI Inflammation -Post	80	2.05	2.72	11.00	0.00	11.00
Small Intestine & Pancreas Pre	102	4.14	4.28	24.00	0.00	24.00
Small Intestine & Pancreas -Post	80	2.98	3.29	18.00	0.00	18.00
Colon -Pre	102	6.68	5.68	29.00	0.00	29.00
Colon -Post	80	5.44	4.62	28.00	0.00	28.00

SD: Standard deviation;Min: Minimum; Max: Maximum.

Table .5.18: GI symptoms total score at pre and post test intervention

Following the dietary fiber-focused intervention (Table 5.18) , a clear improvement in gastrointestinal (GI) health was observed across multiple domains. Participants reported reduced symptom severity in:

- Gastric function, where the mean score dropped from 5.87 ± 5.14 to 4.01 ± 3.98, reflecting fewer complaints like indigestion, bloating, or fullness after meals.
- GI inflammation symptoms saw a decrease from 2.64 ± 3.78 to 2.05 ± 2.72, indicating a decline in discomforts such as stomach burning and nausea.
- Small intestine and pancreas-related symptoms improved from 4.14 ± 4.28 to 2.98 ± 3.29, suggesting better digestion and reduced abnormal bowel habits.
- Colon symptoms, including constipation and bloating, also reduced from 6.68 ± 5.68 to 5.44 ± 4.62.

Overall, these results highlight the effectiveness of the intervention in addressing and alleviating common GI issues, reinforcing the importance of dietary fiber education in promoting better digestive health.

6. CONCLUSIONS

This study was done to see if teaching people about dietary fiber could help them eat more of it and improve their digestive health. In the beginning, many participants had low awareness about fiber and were not eating enough. Because of this, they often faced problems like bloating, constipation, and indigestion. This reflects common eating habits seen in many urban areas today, where processed and low-fiber foods are popular.

After the educational session, participants became more aware of fiber-rich foods and started making healthier food choices. As a result, they reported fewer digestive problems and better gut health. Issues like stomach pain, gas, and irregular bowel movements became less frequent. The improvements were confirmed using statistical tests, which showed the changes were meaningful.

These findings support earlier research that shows fiber plays an important role in keeping the digestive system healthy. They also prove that simple nutrition education can lead to real improvements in eating habits and health. Although the study had a few limitations, such as a small sample size, short study period, and self-reported data, the overall results were positive.

In conclusion, this research shows that increasing fiber intake through nutrition education can improve digestive health. It also suggests that similar programs can be useful in other communities, helping people prevent digestive issues and improve their overall well-being.

7. ACKNOWLEDGEMENT

I would like to sincerely express my deep gratitude to **Ms. Sneha Ambre Desale** for the invaluable guidance, constant support, and expert supervision throughout the course of this research. Her insightful feedback, constructive criticism, and unwavering encouragement have been instrumental in shaping the direction and depth of this thesis. Without her mentorship and patience, the completion of this work would not have been possible.

A special thanks to the Head of the Department **Ms. Datta Patel**, for providing unwavering support and fostering an environment conducive to research and learning.

I am also immensely grateful to **D.Y. Patil University** for providing the academic environment, research facilities, and technical support required for carrying out this study.

I wish to extend my sincere appreciation to the respected members of the thesis evaluation committee for taking the time to review my work and for providing valuable comments, suggestions, and recommendations that greatly contributed to enhancing the quality of this thesis.
I would also like to acknowledge the cooperation of my colleagues and fellow researchers, whose insights, discussions, and shared experiences enriched my understanding and motivated me to persevere through challenges.
On a personal note, I am deeply indebted to my family and friends for their unconditional love, patience, and understanding throughout this academic journey. Their emotional support, encouragement during difficult times, and belief in my abilities have been a constant source of strength and inspiration.
Lastly, I extend my heartfelt gratitude to all those who, directly or indirectly, have supported and contributed to the successful completion of this thesis.

8. REFERENCES

[1]. Samantha K. Gill, Megan Rossi, Balazas Bajka and Kevin Whelan. (2020).**Dietary fibre in gastrointestinal health and disease.** https://doi.org/10.1038/s41575-020-00375-4

[2]. Eswaran, Shanti MD, Muir, Jane PhD, Chey, William D MD, AGAF, FACG, FACP. (2013). **Fiber and Functional Gastrointestinal Disorders.** DOI:10.1038/ajg.2013.63

[3]. Evelien Snauwaert, Fabio Paglialonga, Johan Vande Walle, Mandy Wan, An Desloovere, Nonnie Polderman, Jose Renken-Terhaerdt, Vanessa Shaw and Rukshana Shroff. (2022). T**he benefits of dietary fiber: the gastrointestinal tract and beyond**. https://doi.org/10.1007/s00467-022-05837-2

[4]. Semih Ötles, Selin Ozgoz Department of Food Engineering, Engineering Faculty, Ege University of Izmir, Turkey. (2014). **Health Effects of Dietary Fiber.** https://doi.org/10.17306/J.AFS.2014.2.8

[5]. Judith A Marlett PhD, RD , Michael I McBurney PhD , Joanne L Slavin PhD, RD. (2002). **Position of the American Dietetic Association: Health Implications of Dietary Fiber**. DOI : https://doi.org/10.1016/S0002-8223(02)90228-

[6]. James W Anderson, Pat Baird, Richard H Davis, Jr, Stefanie Ferreri, Mary Knudtson, Ashraf Koraym, Valerie Waters, Christine L Williams. (01 April 2009). **Health benefits of dietary fiber**. DOI : https://doi.org/10.1111/j.1753-4887.2009.00189.x

[7]. D. P. Burkitt, MD, FRS, FRCSE; A. R. P. Walker, DSc; N. S. Painter, MS, FRCS, FACS. (August 19, 1974). **Dietary Fiber and Disease**. DOI : 10.1001/jama.1974.03230460018013

[8]. Hannah D. Holscher. (27 Feb 2017). **Dietary fiber and prebiotics and the gastrointestinal microbiota.** DOI : https://doi.org/10.1080/19490976.2017.1290756

[9]. Christine Dominianni, Rashmi Sinha, James J. Goedert, Zhiheng Pei, Liying Yang, Richard B. Hayes, Jiyoung Ahn. (April 15, 2015). **Sex, Body Mass Index, and Dietary Fiber Intake Influence the Human Gut Microbiome**. DOI : https://doi.org/10.1371/journal.pone.0124599

[10]. James M. Lattimer and Mark D. Haub. (15 December 2010). **Effects of Dietary Fiber and Its Components on Metabolic Health**. DOI : https://doi.org/10.3390/nu2121266

[11]. Deepak Mudgil. (14 July 2017). **Chapter 3 - The Interaction Between Insoluble and Soluble Fiber.** DOI : https://doi.org/10.1016/B978-0-12-805130-6.00003-

[12]. A. E. Quirós-Sauceda,a H. Palafox-Carlos,a S. G. Sáyago-Ayerdi,b J. F. Ayala-Zavala,a L. A. Bello-Perez,c E. Álvarez-Parrilla,d L. A. de la Rosa,d A. F. González-Córdovaa and G. A. González-Aguilar*. (Issue 6, 2014). **Dietary fiber and phenolic compounds as functional ingredients: interaction and possible effect after ingestion**

[13]. Anderson JW, Smith BM, Gustafson NJ. (May 1994). **Health benefits and practical aspects of high-fiber diets**. DOI : https://doi.org/10.1093/ajcn/59.5.1242S

[14]. Gustavo A González-Aguilar 2, Francisco J Blancas-Benítez 1, Sonia G Sáyago-Ayerdi. (February 2017). **Polyphenols associated with dietary fibers in plant foods: molecular interactions and bioaccessibility**. DOI : https://doi.org/10.1016/j.cofs.2017.03.004

[15]. Marie-Luise Puhlmann, Willem Meindert De Vos. (18 August 2022). **Intrinsic dietary fibers and the gut microbiome: Rediscovering the benefits of the plant cell matrix for human health**. DOI : https://doi.org/10.3389/fimmu.2022.954845

[16]. Edoardo Capuano. (25 May 2017). **The behavior of dietary fiber in the gastrointestinal tract determines its physiological effect**. DOI : https://doi.org/10.1080/10408398.2016.1180501

[17]. Barbara A. Williams, Lucas J. Grant , Michael J. Gidley, and Deirdre Mikkelsen. (20 October 2017). **Gut Fermentation of Dietary Fibres: Physico-Chemistry of Plant Cell Walls and Implications for Health.** DOI : https://doi.org/10.3390/ijms18102203

[18]. Silvia Salvator, Maria Serena Battigaglia, Elena Murone, Eugenia Dozio, Licia Pensabene and Massimo Agosti. (6 May 2023). **Dietary Fibers in Healthy Children and in Pediatric Gastrointestinal Disorders: A Practical Guide**. DOI: https://doi.org/10.3390/nu15092208

[19]. Shuxin Ye a, Bakht Ramin Shah b, Jing Li a, Hongshan Liang a, Fuchao Zhan a, Fang Geng c, Bin Li . (June, 2022). **A critical review on interplay between dietary fibers and gut microbiota**. DOI : https://doi.org/10.1016/j.tifs.2022.04.010

[20]. George V. Vahouny and Marie M. Cassidy. (December 1985). **Dietary Fibers and Absorption of Nutrients**. DOI : https://doi.org/10.3181/00379727-180-42200

[21]. Oscar J. Tejeda and Woo K. Kim. (9 February 2021). **Role of Dietary Fiber in Poultry Nutrition.** DOI : https://doi.org/10.3390/ani11020461

[22]. Martin A. Eastwood, William Cordon Brydon & Kebede Tadesse. (1980). **Effect of Fiber on Colon Function.**

[23]. Andoh, A.; Tsujikawa, T.; Fujiyama, Y. (Number 4, 2003). **Role of Dietary Fiber and Short-Chain Fatty Acids in the Colon**. DOI : https://doi.org/10.2174/1381612033391973

[24]. Cummings JH 1 2, Hill MJ, Jenkins D J A, Pearson JR, Wiggins HS. (December 1976). **Changes in fecal composition and colonic function due to cereal fiber.** DOI : https://doi.org/10.1093/ajcn/29.12.1468

[25]. Craig Hillemeier. (NOVEMBER 01 1995). **An Overview of the Effects of Dietary Fiber on Gastrointestinal Transit**. DOI : https://doi.org/10.1542/peds.96.5.997

[26]. Liza Bowen , Shah Ebrahim, Bianca De Stavola, Andy Ness, Sanjay Kinra, A.V. Bharathi, Dorairaj Prabhakaran, K. Srinath Reddy. (June 22, 2011). **Dietary Intake and Rural-Urban Migration in India: A Cross-Sectional Study.** DOI : **https://doi.org/10.1371/journal.pone.0014822**

[27]. Singh, A., & Singh, S. N. (2015). **Dietary fiber content of Indian diets**. Asian J Pharm Clin Res, 8(3), 58-61.

[28]. Nayga Jr, R. M. (1996). **Dietary fiber intake away-from-home and at-home in the United States**. Food Policy, 21(3), 279-290.

[29]. Mattos, L. L. D., & Martins, I. S. (2000). **Dietary fiber consumption in an adult population.** Revista de Saúde Pública, 34, 50-55.

[30]. King, D. E., Mainous III, A. G., & Lambourne, C. A. (2012). **Trends in dietary fiber intake in the United States, 1999-2008**. Journal of the Academy of Nutrition and Dietetics, 112(5), 642-648.

[31]. Rahim, A. T. M., & Choudhury, R. (2005). **Perceived Role of Dietary Fiber in Healthy Diet and its intake pattern among educated urban population**. Bangladesh Journal of Nutrition, 61-68.

[32]. Alfawaz, H., Khan, N., Alhuthayli, H., Wani, K., Aljumah, M. A., Khattak, M. N. K., ... & Al-Daghri, N. M. (2020). **Awareness and knowledge regarding the consumption of dietary fiber and its relation to self-reported health status in an adult Arab population: a cross-sectional study**. International Journal of Environmental Research and Public Health, 17(12), 4226.

[33]. Guiné, R. P., Ferreira, M., Correia, P., Duarte, J., Leal, M., Rumbak, I., ... & Straumite, E. (2016). **Knowledge about dietary fibre: a fibre study framework.** International journal of food sciences and nutrition, 67(6), 707-714.

[34]. Guine, R. P., Duarte, J., Ferreira, M., Correia, P., Leal, M., Rumbak, I., ... & Straumite, E. (2016). **Knowledge about sources of dietary fibres and health effects using a validated scale: a cross-country study.** Public Health, 141, 100-112.

[35]. Ljubičić, M., Sarić, M. M., Rumbak, I., Barić, I. C., Sarić, A., Komes, D., ... & Guiné, R. P. (2022). **Is better knowledge about health benefits of dietary fiber related to food labels reading habits? A Croatian overview**. Foods, 11(15), 2347.

[36]. Padmawar, A. R. (2023). **INDIAN DIETARY FIBERS, THEIR ROLE IN HEALTH MANAGEMENT AND DISEASE PREVENTION**. European Journal of Biomedical, 10(11), 317-323.

[37]. Kumar, J., Rani, K., & Datt, C. (2020). **Molecular link between dietary fibre, gut microbiota and health**. Molecular Biology Reports, 47(8), 6229-6237.

[38]. Hillemeier, C. (1995). **An overview of the effects of dietary fiber on gastrointestinal transit**. Pediatrics, 96(5), 997-999.

[39]. Voderholzer, W. A., Schatke, W., Mühldorfer, B. E., Klauser, A. G., Birkner, B., & Müller-Lissner, S. A. (1997). **Clinical response to dietary fiber treatment of chronic constipation.** American Journal of Gastroenterology (Springer Nature), 92(1).

[40]. Bliss, D. Z., Savik, K., Jung, H. J. G., Whitebird, R., & Lowry, A. (2011). **Symptoms associated with dietary fiber supplementation over time in individuals with fecal incontinence**. Nursing research, 60(3), S58-S67.

[41]. Klosterbuer, A., Roughead, Z. F., & Slavin, J. (2011). **Benefits of dietary fiber in clinical nutrition.** Nutrition in Clinical Practice, 26(5), 625-635.

[42]. Mceligot, A. J., Gilpin, E. A., Rock, C. L., Newman, V., Hollenbach, K. A., Thomson, C. A., & Pierce, J. P. (2002). **High dietary fiber consumption is not associated with gastrointestinal discomfort in a diet intervention trial.(Research and Professional Briefs)**. Journal of the American Dietetic Association19, 102(4), 549-552.

[43]. Brotherton, C. S., Taylor, A. G., Bourguignon, C., & Anderson, J. G. (2014). **A high-fiber diet may improve bowel function and health-related quality of life in patients with Crohn disease.** Gastroenterology Nursing, 37(3), 206-216.

[44]. Morozov, S., Isakov, V., & Konovalova, M. (2018). **Fiber-enriched diet helps to control symptoms and improves esophageal motility in patients with non-erosive gastroesophageal reflux disease**. World journal of gastroenterology, 24(21), 2291.

[45]. Pettersson, A., Nygren, P., Persson, C., Berglund, A., Turesson, I., & Johansson, B. (2014). **Effects of a dietary intervention on gastrointestinal symptoms after prostate cancer radiotherapy: long-term results from a randomized controlled trial**. Radiotherapy and Oncology, 113(2), 240-247.

[46]. Burkitt, D. P., Walker, A. R. P., & Painter, N. S. (1974). **Dietary fiber and disease**. Jama, 229(8), 1068-1074.

[47]. Liu, T., Liu, B., Jiang, Y. Q., Ojo, O., Jiang, X. S., Wang, Y. Y., ... & Wang, X. H. (2024). **Effects of different dietary fiber supplement strategies on incidence of acute gastrointestinal injury in ICU patients: A prospective observational study**. Intensive and Critical Care Nursing, 84, 103673.

[48]. Ganda Mall, J. P., Löfvendahl, L., Lindqvist, C. M., Brummer, R. J., Keita, Å. V., & Schoultz, I. (2018). **Differential effects of dietary fibres on colonic barrier function in elderly individuals with gastrointestinal symptoms**. Scientific Reports, 8(1), 13404.

[49]. Stewart, M. L., Nikhanj, S. D., Timm, D. A., Thomas, W., & Slavin, J. L. (2010). **Evaluation of the effect of four fibers on laxation, gastrointestinal tolerance and serum markers in healthy humans**. Annals of Nutrition and Metabolism, 56(2), 91-98.

[50]. Meldrum, O. W., & Yakubov, G. E. (2024). **Journey of dietary fiber along the gastrointestinal tract: role of physical interactions, mucus, and biochemical transformations**. Critical Reviews in Food Science and Nutrition, 1-29.

[51]. Zhang, Z., Xu, G., Ma, M., Yang, J., & Liu, X. (2013). **Dietary fiber intake reduces risk for gastric cancer: a meta-analysis.** Gastroenterology, 145(1), 113-120.

[52]. Bacha, A. A., Suhail, M., Awwad, F. A., Ismail, E. A., & Ahmad, H. (2024). **Role of dietary fiber and lifestyle modification in gut health and sleep quality.** Frontiers in Nutrition, 11, 1324793.

[53]. Crincoli, C. M., Garcia-Campayo, V., Rihner, M. O., Nikiforov, A. I., Liska, D., & van de Ligt, J. L. (2016). **Evaluation of the gastrointestinal tolerability of corn starch fiber, a novel dietary fiber, in two independent randomized, double-blind, crossover studies in healthy men and women.** International Journal of Food Sciences and Nutrition, 67(7), 844-856.

[54]. McRorie Jr, J. W., & McKeown, N. M. (2017). **Understanding the physics of functional fibers in the gastrointestinal tract: an evidence-based approach to resolving enduring misconceptions about insoluble and soluble fiber**. Journal of the Academy of Nutrition and Dietetics, 117(2), 251-264.

[55]. Tungland, B. C., & Meyer, D. (2002). **Nondigestible oligo-and polysaccharides (Dietary Fiber): their physiology and role in human health and food.** Comprehensive reviews in food science and food safety, 1(3), 90-109.

[56]. McDonald, J., Pirhonen, D., & Rangam, M. A. (1983). **High fiber diets: their role in gastrointestinal disorders**. Canadian Family Physician, 29, 1632.

[57]. Papathanasopoulos, A., & Camilleri, M. (2010). **Dietary fiber supplements: effects in obesity and metabolic syndrome and relationship to gastrointestinal functions.** Gastroenterology, 138(1), 65-72.

[58]. Brotherton, C. S., & Taylor, A. G. (2013). **Dietary fiber information for individuals with Crohn disease: reports of gastrointestinal effects.** Gastroenterology Nursing, 36(5), 320-327.

[59]. Yao, C. K., Gibson, P. R., & Shepherd, S. J. (2013). **Design of clinical trials evaluating dietary interventions in patients with functional gastrointestinal disorders.** Official journal of the American College of Gastroenterology| ACG, 108(5), 748-758.

[60]. Croisier, E., Brown, T., & Bauer, J. (2021). **The efficacy of dietary fiber in managing gastrointestinal toxicity symptoms in patients with gynecologic cancers undergoing pelvic radiotherapy: a systematic review**. Journal of the Academy of Nutrition and Dietetics, 121(2), 261-277.

[61]. So, D., Whelan, K., Rossi, M., Morrison, M., Holtmann, G., Kelly, J. T., ... & Campbell, K. L. (2018). **Dietary fiber intervention on gut microbiota composition in healthy adults: a systematic review and meta-analysis**. The American journal of clinical nutrition, 107(6), 965-983.

[62]. Markland, A. D., Palsson, O., Goode, P. S., Burgio, K. L., Busby-Whitehead, J., & Whitehead, W. E. (2013). **Association of low dietary intake of fiber and liquids with constipation: evidence from the National Health and Nutrition Examination Survey**. Official journal of the American College of Gastroenterology| ACG, 108(5), 796-803.

[63]. Clark, M. J., & Slavin, J. L. (2013). **The effect of fiber on satiety and food intake: a systematic review.** Journal of the American College of Nutrition, 32(3), 200-211.

[64]. Morais, M. B., Vítolo, M. R., Aguirre, A. N., & Fagundes-Neto, U. (1999). **Measurement of low dietary fiber intake as a risk factor for chronic constipation in children**. Journal of pediatric gastroenterology and nutrition, 29(2), 132-135.

[65]. Ho, K. S., Tan, C. Y. M., Daud, M. A. M., & Seow-Choen, F. (2012). **Stopping or reducing dietary fiber intake reduces constipation and its associated symptoms**. World Journal of Gastroenterology: WJG, 18(33), 4593.

[66]. Chan, A. O. O., Leung, G., Tong, T., & Wong, N. Y. (2007). **Increasing dietary fiber intake in terms of kiwifruit improves constipation in Chinese patients.** World journal of gastroenterology: WJG, 13(35), 4771.

[67]. Murakami, K., Sasaki, S., Okubo, H., Takahashi, Y., Hosoi, Y., & Itabashi, M. (2007). **Association between dietary fiber, water and magnesium intake and functional constipation among young Japanese women**. European journal of clinical nutrition, 61(5), 616-622.

[68]. Stewart, M. L., & Schroeder, N. M. (2013). **Dietary treatments for childhood constipation: efficacy of dietary fiber and whole grains.** Nutrition reviews, 71(2), 98-109.

[69]. Dukas, L., Willett, W. C., & Giovannucci, E. L. (2003). **Association between physical activity, fiber intake, and other lifestyle variables and constipation in a study of women**. Official journal of the American College of Gastroenterology| ACG, 98(8), 1790-1796.

[70]. Shen, L., Huang, C., Lu, X., Xu, X., Jiang, Z., & Zhu, C. (2019). **Lower dietary fibre intake, but not total water consumption, is associated with constipation: a population-based analysis**. Journal of Human Nutrition and Dietetics, 32(4), 422-431.

[71]. Van Der Schoot, A., Drysdale, C., Whelan, K., & Dimidi, E. (2022). **The effect of fiber supplementation on chronic constipation in adults: an updated systematic review and meta-analysis of randomized controlled trials**. The American journal of clinical nutrition, 116(4), 953-969.

[72]. Yang, C., Hong, Q., Wu, T., Fan, Y., Shen, X., & Dong, X. (2024). **Association between dietary intake of live microbes and chronic constipation in adults**. The Journal of Nutrition, 154(2), 526-534.

[73]. Abdullah, M. M., Gyles, C. L., Marinangeli, C. P., Carlberg, J. G., & Jones, P. J. (2015). **Dietary fibre intakes and reduction in functional constipation rates among Canadian adults: a cost-of-illness analysis.** Food & nutrition research, 59(1), 28646.

[74]. Ghanbari, M., Rajati, F., & Salehi, L. (2023). **Fiber Consumption in Constipated Older Adults; a Theory-Based Interventional Study.** Health Education and Health Promotion, 11(3), 485-492.

[75]. Zhou, J. (2023). **Effects of Dietary Fibre on People with Constipation**. Theoretical and Natural Science, 4, 56-64.

[76]. Cummings, J. H. (1984). **Constipation, dietary fibre and the control of large bowel function.** Postgraduate Medical Journal, 60(709), 811.

[77]. Liu, Q., Kang, Y., & Yan, J. (2022). **Association between overall dietary quality and constipation in American adults: a cross-sectional study.** BMC public health, 22(1), 1971.

[78]. Yang, S., Wu, X. L., Wang, S. Q., Guo, X. L., Guo, F. Z., & Sun, X. F. (2022). **Association of dietary energy intake with constipation among men and women: results from the national health and nutrition examination survey.** Frontiers in Nutrition, 9, 856138.

[79]. Gemini, S., Lolo, L. L., Sumiati, S., Ezdha, A. U. A., & Susanti, N. Y. (2022). **Correlation of fiber intakes with incidence of constipation in the elderly.** International Journal of Social Sciences and Humanities, 6(1), 58-65.

[80]. Towers, A. L., Burgio, K. L., Locher, J. L., Merkel, I. S., Safaeian, M., & Wald, A. (1994). **Constipation in the elderly: influence of dietary, psychological, and physiological factors.** Journal of the American Geriatrics Society, 42(7), 701-706.