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Assessment of Cereal-Based Ultra-Processed Food Consumption and Self-Reported Gastrointestinal Symptoms among Young Adults

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Abstract: *A descriptive cross-sectional study assessed cereal-based ultra-processed food (UPF) consumption and its association with self-reported gastrointestinal (GI) symptoms among 100 young adults aged 18–30 years. Cereal-based UPFs, including packaged biscuits, instant noodles, breakfast cereals, and packaged breads, are widely consumed due to their convenience and availability. Their high content of refined carbohydrates, sugars, fats, sodium, and additives, along with low dietary fibre, may contribute to GI discomfort. Participants were selected through convenience sampling and completed a structured questionnaire covering socio-demographic characteristics, lifestyle factors, cereal-based UPF intake during the previous month, GI symptoms during the previous three months, and food-label awareness. Data were analysed using descriptive statistics and the Chi-square test, with statistical significance set at $p < 0.05$. The majority of participants reported moderate cereal-based UPF consumption (78%), while 13% had high consumption and 9% had low consumption. Packaged biscuits/cookies, namkeen, instant noodles/pasta, packaged breads/buns, and breakfast cereals were the most commonly consumed products. Most GI symptoms, including abdominal pain, bloating, acidity, constipation, and diarrhoea, were reported as absent or occasional. No statistically significant association was observed between cereal-based UPF consumption and GI symptom category ($\chi^2 = 1.175$, $p = 0.556$). Monthly family income was also not significantly associated with UPF consumption ($\chi^2 = 1.933$, $p = 0.748$) or GI symptoms ($\chi^2 = 7.454$, $p = 0.059$). The findings indicate that cereal-based UPFs were commonly consumed at moderate levels among young adults; however, no significant association with self-reported GI symptoms was observed in the present sample. Further studies should include larger and more diverse samples, along with validated dietary assessment tools, to better understand this relationship.*

Keywords: Ultra-processed foods; cereal-based foods; young adults; gastrointestinal symptoms; dietary habits; food-label awareness

I. INTRODUCTION

Eating patterns among young adults have changed considerably over the past few decades. Reliance on freshly home-cooked meals has gradually declined, largely because of academic pressure, hostel living, and hectic schedules that push students towards quick and convenient food options. As a consequence, ultra-processed foods (UPFs) — industrially manufactured products formulated with additives such as preservatives, colourings, emulsifiers, and

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artificial sweeteners to enhance taste, texture, and shelf life — have become an increasingly common part of daily diets [1]. In urban Indian cities such as Hyderabad, this transition is more pronounced owing to the easy availability of supermarkets, fast-food outlets, and online food-delivery services.

The widely used NOVA classification groups foods by the extent and purpose of processing: unprocessed or minimally processed foods, processed culinary ingredients, processed foods, and ultra-processed foods. Cereal-based UPFs — products mainly derived from wheat, rice, corn, or oats that undergo extensive industrial processing — form a major sub-category, including breakfast cereals, biscuits, cookies, crackers, instant noodles, packaged bread, and cereal bars. During processing, natural fibre, vitamins, and minerals are reduced while sugar, salt, refined flour, and additives are added, so that these products differ markedly in nutritional quality from the whole grains they originate from.

Gastrointestinal health depends on a balanced gut microbiota that supports digestion, immunity, and metabolic regulation. Diets low in fibre and high in ultra-processed foods may alter gut microbial composition, a condition described as gut dysbiosis, which can manifest as increased gas formation, bloating, constipation, acidity, and abdominal discomfort. Epidemiological evidence links high UPF intake with poor diet quality and a greater risk of obesity, metabolic syndrome, and gastrointestinal disorders, largely attributed to low fibre intake and microbiota alterations [2].

Young adults are among the highest consumers of UPFs because of busy lifestyles, hostel living, irregular meal timings, and easy access to packaged foods, with economic status further shaping the specific products consumed. Although research on UPFs has grown substantially, most studies examine broad health outcomes such as obesity and cardiovascular disease, with comparatively little attention to gastrointestinal symptoms, and fewer still isolate the cereal-based sub-category or focus on Indian young adults specifically. The present study was designed to address this gap by assessing cereal-based UPF consumption and its association with self-reported gastrointestinal symptoms among young adults, with the aim of contributing evidence that can inform nutrition-awareness programmes and healthier dietary choices.

II. Aims and Objectives

Aim: To assess the consumption pattern of cereal-based UPFs and their possible association with gastrointestinal symptoms among Indian young adults.

Objectives:

1. To assess cereal-based UPF consumption.
2. To assess gastrointestinal symptoms.
3. To determine the association between UPF consumption and GI symptoms.
4. To study the association of income with UPF consumption and GI symptoms.

III. Review of Literature

A. Studies related to ultra-processed foods

Monteiro et al. [1] outlined the NOVA classification and explained that UPFs are industrially formulated products identifiable through ingredient lists containing substances rarely used in home cooking, such as hydrogenated oils or hydrolysed proteins, along with cosmetic additives. Ghosh-Jerath et al. [9] validated a Nova-UPF Screener for the Indian population across 304 adults, reporting excellent agreement with 24-hour recall-based UPF energy estimates and finding that nearly half of participants had moderate UPF scores. Misra et al. [15] and Popkin and Ng [19] traced India's nutrition transition, showing a decline in traditional cereal, pulse, fruit, and vegetable intake alongside rising fat, salt, and processed-food consumption, contributing to a double burden of malnutrition. Mediratta et al. [13] found that UPFs contributed 17% of energy intake among Indian adults and were linked with reduced dietary diversity and micronutrient inadequacy, while Bielemann et al. [4] reported that UPFs contributed over half of daily energy intake among Brazilian young adults and were inversely associated with fibre intake. Menon et al. [14] observed that UPFs

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contributed 9.3% of energy intake among South Indian college students, driven mainly by convenience and commercial influence.

B. Studies related to UPFs and gut health

Whelan et al. [24] and Rondinella et al. [20] reviewed evidence that UPF additives emulsifiers, artificial sweeteners, and micro/nanoparticles can alter the gut microbiome, increase intestinal permeability, and promote inflammation, potentially contributing to irritable bowel syndrome and other gastrointestinal disorders. Brichacek et al. [5] similarly linked UPF consumption with reduced microbial diversity, though they noted inconsistencies in how the NOVA system is applied across studies. Elizabeth et al. [7] reviewed 43 studies and found that 37 reported a significant association between high UPF intake and at least one adverse health outcome, including irritable bowel syndrome. In contrast, Ghosh and Muley [10], studying 110 university students in Pune, found no significant association between UPF intake and bowel habits or gastrointestinal symptoms, although UPF intake was linked with higher visceral fat. Schnabel et al. [21], in a large French cohort of over 33,000 adults, reported a significant association between UPF intake and irritable bowel syndrome but not with functional constipation, diarrhoea, or dyspepsia. Grabitske and Slavin [11] noted that low-digestible carbohydrates and sugar alcohols, sometimes present in processed foods, can independently cause bloating and abdominal discomfort through colonic fermentation.

C. Studies related to UPFs and socio-economic factors

Baker et al. [3] documented a global rise in UPF sales driven by industrialisation, globalisation, and weak regulatory environments, with the fastest growth occurring in Asia, the Middle East, and Africa. Sharma et al. [22] compared Indian dietary patterns with the EAT-Lancet reference diet and found that processed foods contributed more calories than fruits in the average Indian diet across income groups. Jain and Mathur [12] reported that UPFs contributed 16.2% of energy intake among Delhi adolescents, with middle-income adolescents consuming significantly more than those from low-income households.

D. Studies related to UPFs and cereal-based food items

Morales et al. [17] found that 59% of commercial breakfast cereals were classified as ultra-processed under NOVA and contained significantly more sugar than processed cereals, though heat-induced contaminant levels did not differ significantly. Srour et al. [23] proposed that mechanisms beyond nutrient composition — including additives, altered food structure, and processing contaminants — may explain associations between UPFs and gastrointestinal and metabolic disturbances. A formative Indian market-mapping study [18] identified 81 UPF items across 23 categories, noting the absence of a standardised Indian UPF classification and highlighting breads, chips, and sugar-sweetened beverages as the most preferred UPFs.

Collectively, the reviewed literature indicates growing global and Indian evidence linking UPF consumption with adverse metabolic and gastrointestinal outcomes, though findings on gastrointestinal symptoms specifically remain mixed, and very few Indian studies have isolated cereal-based UPFs as a distinct exposure. This gap forms the basis of the present study.

IV. METHODOLOGY

A. Research design

The study was conducted using a descriptive cross-sectional research design.

B. Sample area and population

The study was conducted among university students and young adults from the surrounding community, approached through online and offline methods. The study population consisted of young adults aged 18–30 years.

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C. Sample size and technique

The minimum sample size was estimated using $n = (Z^2 \times p \times q) / d^2$, with $Z = 1.96$ (95% confidence level), $p = q = 0.50$, and $d = 0.10$, yielding a minimum requirement of 96 participants. To allow for non-response and incomplete questionnaires, the sample was rounded up to 100 participants, recruited using a convenience sampling technique appropriate for a time-bound postgraduate dissertation.

D. Inclusion and exclusion criteria

Inclusion criteria: university students and young adults aged 18–30 years from the surrounding community who were willing to participate. Exclusion criteria: individuals below 18 or above 30 years of age, and individuals unwilling to participate.

E. Data collection tool

Data were collected using a structured questionnaire covering six sections: (A) socio-demographic profile — age, gender, education, occupation, monthly family income, residence, and family type; (B) health profile — height, weight, BMI, diagnosed gastrointestinal disorders, digestive discomfort in the previous six months, and self-rated digestive health; (C) lifestyle and behavioural factors — physical activity, screen time, meal skipping, eating outside, snacking, and water intake; (D) cereal-based UPF consumption — frequency, type, portion size, timing, and reasons for consumption over the previous month; (E) gastrointestinal symptoms — abdominal pain, bloating, acidity, constipation, diarrhoea, gas, and nausea over the previous three months; and (F) food-label awareness. A pilot study among 10 young adults was conducted to check clarity and feasibility, and necessary modifications were made before final data collection.

F. Statistical analysis

Data were entered and analysed using Microsoft Excel. Frequency and percentage were used for descriptive analysis, and the Chi-square test ($\chi^2 = \Sigma(O-E)^2/E$) was used to assess associations between cereal-based UPF consumption, gastrointestinal symptoms, and selected socio-demographic variables, with $p < 0.05$ considered statistically significant.

G. Ethical considerations

Participation was voluntary, confidentiality of participant information was maintained, and data were used only for academic purposes.

V. Results and Discussion

Cereal-based UPFs, such as packaged biscuits, instant noodles, breakfast cereals, and ready-to-eat cereal snacks, are commonly consumed products that may influence dietary patterns and gastrointestinal health. Data were organised and analysed to describe consumption patterns, gastrointestinal symptoms, and the influence of selected socio-demographic and lifestyle factors.

Table I. Socio-Demographic Characteristics of the Study Participants (N = 100)

Variable	Category	n
Age (years)	18–20	36
	21–23	51
	24–27	13
Gender	Female	86
	Male	14
Educational status	Undergraduate	54

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	Postgraduate	46
Occupation	Student	88
	Employed	8
	Self-employed	2
	Unemployed	2
Monthly family income (₹)	<20,000	34
	20,000–40,000	28
	40,001–60,000	21
	>60,000	17
Place of residence	Urban	55
	Semi-urban	19
	Rural	26
Type of family	Nuclear	74
	Joint	26

Most participants (51%) were aged 21–23 years, 86% were female, and 54% were undergraduate students. The majority (88%) were students by occupation, about one-third (34%) belonged to families with a monthly income below ₹20,000, 55% resided in urban areas, and 74% belonged to nuclear families — indicating a predominantly urban, female, undergraduate sample typical of the young-adult population targeted by this study.

Table II. Health Profile of the Study Participants (N = 100)

Variable	**Category**	**n**
Body mass index	Underweight	19
	Normal	59
	Overweight	19
	Obese	3
Diagnosed GI disorder	Yes	7
	No	93
Digestive discomfort (past 6 months)	Yes	22
	No	78
Overall digestive health	Good	51
	Average	44
	Poor	5

The majority (59%) had a normal BMI, and 93% reported no diagnosed gastrointestinal disorder. A history of digestive discomfort in the past six months was reported by 22% of participants, and 51% rated their overall digestive health as good.

Table III. Lifestyle and Behavioural Characteristics of the Study Participants (N = 100)

Variable	**Category**	**n**
Regular physical activity	Yes	72

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	No	28
Screen time	<2 hours	16
	2–4 hours	48
	>4 hours	36
Frequency of eating outside	Daily	5
	3–4 times/week	9
	1–2 times/week	30
	Rarely	56
Meals per day	2 meals	24
	3 meals	67
	>3 meals	9
Frequent meal skipping	Yes	38
	No	62
Meal most commonly skipped	Breakfast	43
	None	35
	Lunch	14
	Dinner	8
Daily water intake	1–2 litres	42
	2–3 litres	37
	<1 litre	8
	>3 litres	13

Most participants (72%) engaged in regular physical activity, 48% reported 2–4 hours of screen time daily, and 56% rarely ate outside. Two-thirds (67%) consumed three meals per day and 62% did not skip meals frequently, though breakfast was the most commonly skipped meal (43%).

Table IV. Frequency of Cereal-Based UPF Consumption Among the Study Participants (N = 100)

Food item	Daily	3–4/wk	1–2/wk	Rarely	Never
Packaged biscuits/cookies	10	12	32	42	4
Instant noodles/pasta	4	6	34	37	19
Breakfast cereals	9	19	27	23	22
Packaged bread/buns	4	7	34	41	14
Bakery items	2	9	27	54	8
Namkeen/snack mixtures	4	11	42	37	6
Ready-to-eat cereal snacks	6	9	24	40	21
Instant oats/porridge mixes	7	12	21	25	35

Cereal-based UPFs were consumed predominantly on an occasional or rare basis rather than daily. Packaged biscuits/cookies were most often consumed rarely (42%), while namkeen/snack mixtures (42%) and instant

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noodles/pasta (34%) were most often consumed 1–2 times per week; instant oats/porridge mixes were never consumed by 35% of participants.

Table V. Consumption Preferences and Purchasing Behaviour (N = 100)

Variable	Category	n
Portion size	Small	43
	Medium	53
	Large	4
Usual time of consumption	Snacks	47
	Other time	26
	Meal replacement	17
	Breakfast	10
Usual place of purchase	Local shops	38
	Supermarkets	36
	Online delivery apps	20
	Canteen	6
Choice of "healthy"-labelled products	Always	47
	Sometimes	39
	Rarely	12
	Never	2
Meal replacement with packaged foods	Sometimes	46
	Rarely	41
	Never	9
	Often	4

Over half (53%) usually consumed a medium portion, and these foods were most commonly eaten as snacks (47%), purchased from local shops (38%) and supermarkets (36%). Nearly half (47%) reported always choosing "healthy"-labelled products.

Table VI. Distribution of Gastrointestinal Symptoms (N = 100)

Symptom	Never	Occasionally	Sometimes	Frequently
Abdominal cramps/pain	32	36	25	7
Bloating/abdominal fullness	34	34	19	13
Acid reflux/heartburn	50	30	12	8
Constipation	40	34	14	12
Diarrhea	62	27	9	2
Excess gas/flatulence	47	32	16	5
Nausea	56	24	15	5

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Occasional abdominal pain/cramps was the most commonly reported symptom (36%). Diarrhoea was the least commonly reported symptom, with 62% of participants reporting never experiencing it. Overall, gastrointestinal symptoms were experienced occasionally or not at all by the majority of participants.

Table VII. Association Between UPF Consumption Category and GI Symptoms (N = 100)

UPF category	High GI symptoms	Low GI symptoms	Total
High	9	4	13
Low	7	2	9
Moderate	64	14	78
Total	80	20	100

The majority of participants (78%) belonged to the moderate UPF-consumption category. High GI symptoms were reported by 82.1% of moderate consumers, 77.8% of low consumers, and 69.2% of high consumers. Descriptive analysis suggested a predominance of GI symptoms among moderate consumers, but the Chi-square test showed no statistically significant association between UPF consumption and GI symptoms ($\chi^2 = 1.175$, df = 2, $p = 0.556$). Gastrointestinal symptoms therefore appeared independent of the level of UPF consumption in this population, possibly reflecting the influence of other factors such as overall dietary pattern, stress, and physical activity, as well as the limited and unequally distributed sample across consumption categories.

Table VIII. Association Between Monthly Family Income and UPF Consumption Category (N = 100)

Income group	High UPF	Low UPF	Moderate UPF	Total
High income	4	3	10	17
Low income	4	4	26	34
Lower-middle income	3	1	24	28
Upper-middle income	2	1	18	21
Total	13	9	78	100

Moderate UPF consumption predominated across all income groups, ranging from 58.8% among high-income participants to 85.7% among lower- and upper-middle-income participants. No statistically significant association was found between income category and UPF consumption ($\chi^2 = 1.933$, df = 4, $p = 0.748$), suggesting that consumption of cereal-based UPFs was prevalent across all income groups, likely reflecting the wide availability, affordability, and convenience of these products regardless of socio-economic status.

Table IX. Association Between Monthly Family Income and GI Symptoms (N = 100)

Income group	High GI symptoms	Low GI symptoms	Total
High income	13	4	17
Low income	26	8	34
Lower-middle income	27	1	28
Upper-middle income	14	7	21
Total	80	20	100

The highest prevalence of high GI symptoms was observed among the lower-middle-income group (96.4%), followed by the high- and low-income groups (76.5% each), while the upper-middle-income group showed the lowest prevalence (66.7%). No statistically significant association was found between monthly family income and GI symptoms ($\chi^2 = 7.454$, df = 3, $p = 0.059$); although this value approached the conventional threshold, it did not reach significance, suggesting that GI symptoms are more likely influenced by factors such as food choices, lifestyle, stress, and individual health conditions than by income alone.

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Overall, these findings are broadly consistent with Bielemann et al. [4] and Mediratta et al. [13], who reported substantial UPF contribution to young-adult diets, but contrast with the stronger UPF–IBS association reported by Schnabel et al. [21] in a much larger French cohort. This discrepancy may reflect the present study's smaller and unequally distributed sample, its focus on a single UPF sub-category, and reliance on self-reported rather than objective dietary and symptom measures, as also noted by Ghosh and Muley [10], who similarly found no significant UPF–GI symptom association among Indian college students. Gastrointestinal symptoms are influenced by multiple factors beyond packaged-food intake, including meal timing, water intake, stress, sleep, fibre intake, and existing digestive conditions, consistent with the mechanistic explanations proposed by Srour et al. [23] and Grabitske and Slavin [11].

VI. CONCLUSION

Cereal-based ultra-processed foods were commonly consumed among young adults in this study, with 78% classified as moderate consumers, 13% as high consumers, and 9% as low consumers. Gastrointestinal symptoms such as abdominal pain, bloating, acidity, constipation, diarrhoea, gas, and nausea were generally reported as absent or occasional. No statistically significant association was found between cereal-based UPF consumption and gastrointestinal symptom category ($\chi^2 = 1.175$, $p = 0.556$), nor between monthly family income and either UPF consumption ($p = 0.748$) or GI symptoms ($p = 0.059$). These findings suggest that gastrointestinal health among young adults cannot be explained by cereal-based UPF consumption alone and is likely shaped by a broader set of dietary, lifestyle, and individual factors. Young adults should nonetheless be encouraged to read food labels, limit frequent intake of highly processed snacks, and maintain regular meals, adequate hydration, and physical activity to support digestive health. The cross-sectional design, convenience sample of 100 participants, and reliance on self-reported data limit the generalisability of these findings. Future research should employ larger and more diverse samples, validated dietary-assessment and symptom-scoring tools, and assessment of total UPF intake alongside factors such as stress, sleep, and fibre intake, ideally using longitudinal or intervention designs to clarify the relationship between ultra-processed food consumption and gastrointestinal health.

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