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RESEARCH ARTICLE

Assessing the millet consumption behaviour among students

P Prema[1] , B Sivasankari[2*], M Ilamaran[2], P Jona Innisai Rani[3], J Arockia Stephen Raj[4] & S Arokia Mary[2]

[1]Agricultural College and Research Institute, Tamil Nadu Agricultural University, Madurai 625 104, Tamil Nadu, India
[2]Community Science College and Research Institute, Tamil Nadu Agricultural University, Madurai 625 104, Tamil Nadu, India
[3]Anbil Dharmalingam Agricultural College and Research Institute, Tiruchirappalli 620 027,Tamil Nadu, India
[4]V.O. Chidambaranar Agricultural College and Research Institute, Killikulam 628 252,Tamil Nadu, India

*Correspondence email - sankari83@tnau.ac.in

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Abstract

Millets, often referred to as “smart food,” are considered beneficial for individuals, the environment and farmers. Despite their advantages, millet production and consumption have declined due to changes in dietary habits and lifestyle shifts, contributing to various nutritional and health issues. Recently, millets have regained popularity due to their numerous health benefits, environmental sustainability and role in promoting food security, as well as their low agricultural inputs, minimal water requirements and potential to provide food and nutritional security. The study aimed to assess both awareness and consumption patterns of millets among students. A structured questionnaire was used to collect data from students in the disciplines of Agriculture, Food and Nutrition and Agricultural Engineering. Data were collected through a structured questionnaire and associations between categorical variables were analysed using the Chi-square test. Results revealed that 87.7 % of respondents were aware of millets, with 45.7 % acknowledging that social media plays a significant role in creating awareness about millets. Among the social media tools, the most prevalent source of millet awareness was food informative blogs (55.6 %), followed by Instagram (43.2 %) and WhatsApp (39.5 %). For respondents who consumed millets, the primary reasons for consumption were the high iron content (72.8 %) and its suitability for diabetics (61.7 %). Additionally, 69.1 % of respondents confirmed that they believed millets were healthy. The most common forms in which students consumed millets were dosa and ready-to-eat food, reported by 19.8 % and 17.3 % of respondents, respectively. These findings suggest that increased awareness about millets contributes to their consumption among students. Therefore, nutrition education on the benefits and uses of millets is crucial to promote their consumption further.

Keywords: food security; grains; health; nutrition; sustainable

Introduction

Millets are increasingly recognised as "smart food" due to their multifaceted benefits: they are nutritious and health-promoting, environmentally sustainable and economically viable for farmers. These climate-resilient crops are capable of withstanding high temperatures, thriving in degraded soils and growing with minimal inputs such as water, pesticides and fertilizers (1). As a result, millet cultivation typically has a lower carbon footprint compared to major crops, which rely heavily on chemical inputs. From a nutritional perspective, millets complement widely consumed Indian legumes, such as pigeon pea and chickpea, by enhancing the overall amino acid profile, including leucine, isoleucine and valine. When combined, they form a complete protein with improved digestibility upon cooking (2). Apart from protein, depending on the variety and species, millets are also rich in minerals, such as iron, zinc and calcium, which deliver health benefits to all age groups and genders. Millets are a traditional staple across different parts of the world. Millets are increasingly recognised as a food that benefits both human health and environmental sustainability (3). They have played a vital role in traditional diets across many regions and are regarded as one of the most important cereal grains. Previously referred to as "coarse cereals," millets have been rebranded as Nutri-cereals in recognition of their rich nutritional profile, particularly their high content of iron, zinc and calcium (4). The Ministry of Agriculture and Farmers Welfare, Government of India initiated this renaming to promote the consumption of millets and their nutritional value. As one of the earliest grains cultivated by humans and among the oldest known foods, millets are often described as a super-grain, superfood and wonder grain (5). In many Indian states, particularly in regions where they are traditionally grown and consumed, such as Rajasthan, Uttar Pradesh, Karnataka, Maharashtra, Gujarat, Haryana, Madhya Pradesh, Tamil Nadu andhra Pradesh and Telangana, millets continue to be an integral part of traditional diets. Their enduring presence in both consumption and cultivation is attributed to their remarkable nutritional and agronomic value. However, the rise of fast-paced lifestyles has led to a shift in food habits, with a growing preference for ready-to-eat and ready-to-cook options over traditional foods. Despite this shift, millets remain relevant due to their non-glutinous nature and rich lecithin content,

making them gentle on the digestive system (6). Lecithin acts as an emulsifier, helping to break down fats and improve the overall digestive process. Millets also offer tremendous health benefits, thanks to their high nutritional content, which can help reduce the risk of several lifestyle-related diseases. Compared to rice and wheat, millets are significantly richer in minerals, dietary fibre, iron, calcium and zinc (7). Certain millet varieties, such as foxtail millet and little millet, are considered nutritionally superior to rice and wheat, which are widely consumed across India (8). Millets have been found to aid in weight management and reduce obesity by promoting satiety and satisfying hunger (9). Several studies on millet-based dietary interventions in diabetic patients have highlighted the potential of millets in reducing blood sugar levels, suggesting that they could become a viable dietary option in the fight against diabetes (10).

Consumers often cite nutritional value, affordability, taste, convenience, weight management benefits and diabetes control as key reasons for choosing millets over traditional staple foods, such as rice and wheat (11). However, the awareness of millets' health benefits remains low, particularly in South India, where rice continues to be the staple food due to its availability and affordability. For many, rice is the preferred choice as it offers a sense of fullness at a lower cost compared to millets (12). India is one of the leading producers of millets globally, followed by Nigeria, with an annual output of around 18 million tons contributing nearly 10 % to the country's total food grain basket. However, millet consumption remains disproportionately low compared to that of rice and wheat (13). A growing segment of the Indian population, driven by increased health awareness, is consciously choosing millets for their preventative health benefits, including reduced risks of heart disease, diabetes and cancer. This choice is also fueled by the belief that millets aid in detoxification and improved digestion. This trend is particularly pronounced among older age groups who may be more focused on health management and disease prevention. Nutritional profiles of various types, such as pearl, finger and small millet, have also been documented (14).

There is also high acceptability of millet-based meals among children, with studies showing improvements in stunting and Body Mass Index. This suggests the potential of millets as a nutritious alternative to rice-based meals, particularly in government programs such as mid-day meals (12, 15).

In summary, the literature establishes that millets offer significant health and nutritional benefits, devising them a healthier alternative to conventional cereals. However, awareness remains limited, particularly among student populations in South India. With most processed foods still being rice- and wheat-based and millet is more nutritious, it becomes essential to examine awareness levels, consumption patterns and the factors, both encouraging and inhibiting, surrounding millet intake among specific demographics, such as urban Indian women and South Indian students. The present study, therefore, aims to explore the motivations, barriers and influences affecting millet consumption in this context.

Materials and Methods

A survey was conducted to gather primary data on opinions regarding millet consumption behaviour among the target population, which consisted of students aged 18 to 25 years. The target group for this survey is likely due to their potential influence on future millet consumption patterns and their representativeness of a broader demographic. This age group is often characterised by a high level of health consciousness, openness to new dietary trends and a significant influence on purchasing habits. To collect primary data on the millet consumption behaviour of students in agriculture, Horticulture and engineering programs at Madurai, Trichy and Coimbatore, as well as school, engineering and medical college students in Madurai, a convenience sampling survey (n = 15) was conducted. The collected data were subjected to statistical analysis to explore the associations and relationships among the identified variables (16). The variables include socio-economic information, Food Frequency, Sources of Information, Awareness of nutritional value, Reason for consumption, frequency of millet consumption, Diet preference and factors that inhibit millet consumption. These variables are widely used to evaluate food choice behaviour among students. A sample of 81 respondents was selected from a group of students using a non-probability, i.e., convenience sampling technique.

Data collection sources

The study was primarily based on primary data, which was collected through a survey using a structured questionnaire. A structured questionnaire was developed to capture both millet consumption patterns and socio-economic information of the respondents. Both qualitative and quantitative questions were posed, accompanied by prompts or predefined options for selection. A picture of four popular food grains was included in the survey. The Statistical Package for the Social Sciences (SPSS) version 27.0 was used to analyse the collected data.

Data Analysis

The data were organised and subjected to statistical analysis using SPSS Statistics version 27. After data cleaning, 81 observations were included in the study (Table 1). Frequency statistics were used to present the knowledge and practices of the participants.

Results and Discussion

The study found that the majority of respondents were in the 19 to 21-year age group. "Among the respondents, 63.7 % were women and 36.3 % were men. Additionally, 78.8 % of respondents were in the 19 - 21-year age group, while 21.3 % were above 21 years. In these survey results, where female students participated and responded, the numbers are greater than those of male students. The details are mentioned in Table 1. The majority of the respondents, 74.1 %, were Agriculture graduates (Fig. 1). The Socio-economic information of the respondents is represented in Fig. 2. The highest average income was greater than 40,000 (39.5 %) and the lowest income ranged from 26,000 - 40,000 (13.6 %).

Table 1. Distribution of respondents by gender and age group

Particulars	Gender		Age	
	Male	Female	>19 and < 21 years	>21 years
Frequency	29	51	63	17
Percentage	36.3	63.7	78.8	21.3

Awareness of millet

The results of the study indicated that nearly 100 % of respondents were aware of the existence of millets. The results revealed that 100 % of the respondents reported knowing millets as a healthy food. The study showed widespread awareness of millets, with over 66 % of respondents recognising varieties such as Foxtail, Finger, Little, Pearl, Barnyard, kodo, Sorghum and Proso millet. Among the millet crops, Finger millet had the highest recognition rate (95.1 %) followed by pearl millet (92.6 %). The level of awareness about the various types of millet among the respondents are listed in Table 2 and Fig. 3.

Knowledge of millet

Among the participants, most did not recognize the images of cumbu, finger millet, kudiraivali and ragi displayed in the questionnaire. Among the four grains, cumbu had the highest recognition rate at 87.7 %, followed by ragi at 64.2 %. The recognition rates for each millet are shown in Table 3-6.

Table 2. Awareness levels of different millet varieties among respondents

Millet Recognition in %	Yes	No
Foxtail millet	76.5	23.5
Finger Millet	95.1	4.9
Little Millet	67.9	32.1
Pearl Millet	92.6	7.4
Barnyard millet	91.4	8.6
Kodo Millet	70.4	29.6
Sorghum Millet	87.7	12.3
Proso Millet	66.7	33.3

Table 3. Respondents' recognition of pearl millet and other varieties

	Frequency	Percent
Pearl Millet	71	87.7
Kudiraivali	8	9.9
Maize	2	2.5
Total	81	100.0

Table 4. Respondents' recognition of finger millet and other varieties

	Frequency	Percent
Pearl Millet	20	24.7
Finger millet	27	33.3
KUDIRAIVALI	27	33.3
Ragi	7	8.6
Total	81	100.0

Table 5. Respondents' recognition of kudiraivali and other varieties

	Frequency	Percent
Pearl Millet	13	16.0
Finger millet	13	16.0
Kudiraivali	52	64.2
Ragi	3	3.7
Total	81	100.0

Table 6. Respondents' recognition of ragi and other varieties

	Frequency	Percent
Finger millet	19	23.5
Kudiraivali	5	6.2
Ragi	57	70.4
Total	81	100.0

Sources of Information on millets

Social media has played a significant role in increasing awareness of millet grains among students The Indian Journal of Agricultural Economics research, for example, found that 27.33 % of respondents cited social media as their source of information on millets (17). The study confirmed that food blogs, Facebook and Instagram are the key platforms for disseminating information about nutri-grains. Among the respondents, social sources platforms like Food and Information blogs were

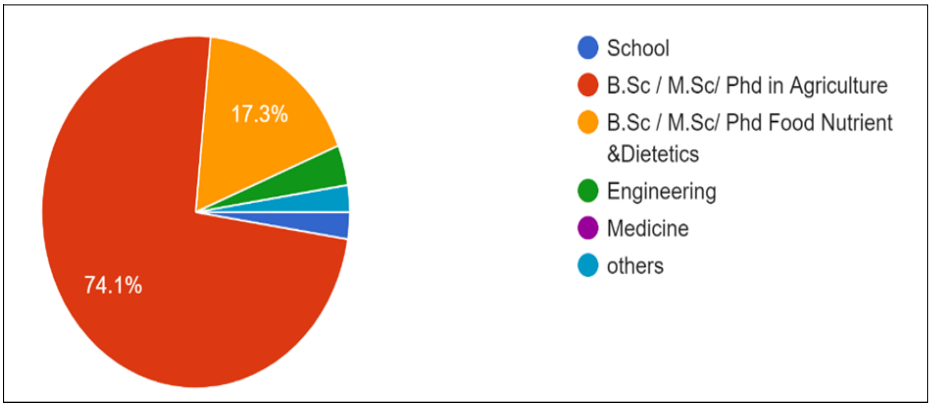

Fig. 1. Educational background of participants.

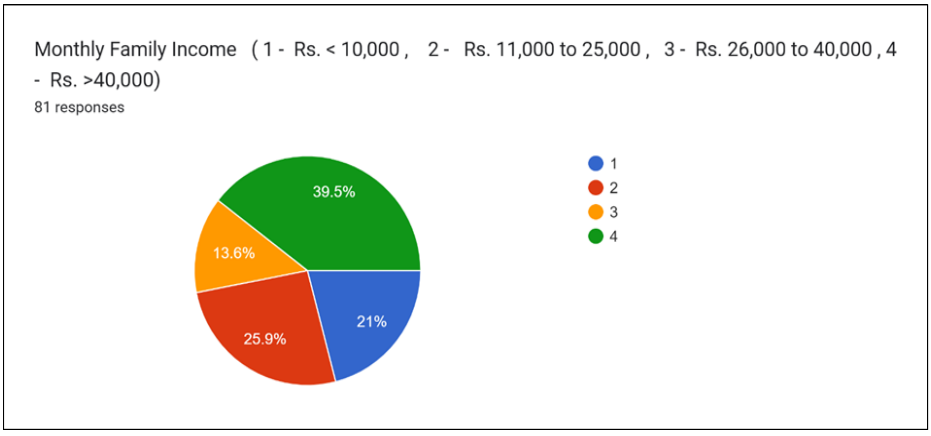

Fig. 2. Socio-economic characteristics of participants.

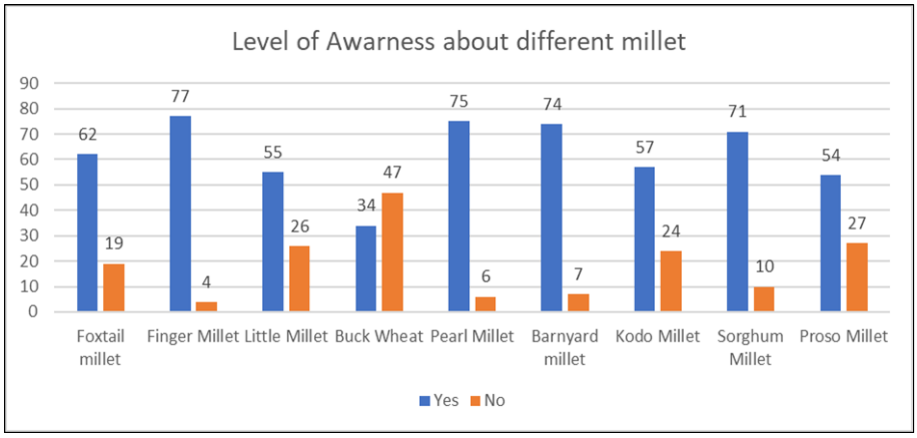

Fig. 3. Awareness of different millet varieties among participants.

identified as the most influential in spreading awareness about millets. Among the social media tools, Predominant type social media which created millet awareness was food informative blogs (55.6 %) followed by Instagram (43.2 %) and WhatsApp (39.5 %) was represented in (Fig. 4).

Regarding their knowledge of millets "45.7 % of respondents" indicated that social media has significantly contributed (Fig. 5). In contrast, courses and books were cited as sources by 58 % of respondents, while family and friends accounted for 37 % of millet-related information. The other influential information sources newspapers (25.9 %), TV Showes (19.8 %), Mobile App (12.3 %), Hotel recipe (9.9 %) and other sources (23.5 %). Most respondents are aware of various millets, but there is a lack of awareness about a few millets, such as proso millet and buckwheat (Fig. 3).

Awareness of nutritional value

Millets are often consumed as an alternative to rice and wheat by individuals who are well-informed about their health benefits. Others choose millets for reasons such as being gluten -free, aiding in weight management, promoting haemoglobin formation, controlling diabetes and blood pressure and reducing the risk of cardiovascular diseases (8, 10). However, the study also revealed that many individuals remain unaware of its full nutritional benefits. Several nutritional benefits are often overlooked, including the importance of fibre, calcium and vitamin D. Fibre is crucial for maintaining digestive health and overall well-being. In contrast, calcium is essential for maintaining strong bones. Vitamin D deficiency can lead to various health issues, including muscle weakness and an increased risk of fractures. This highlights the need for mass

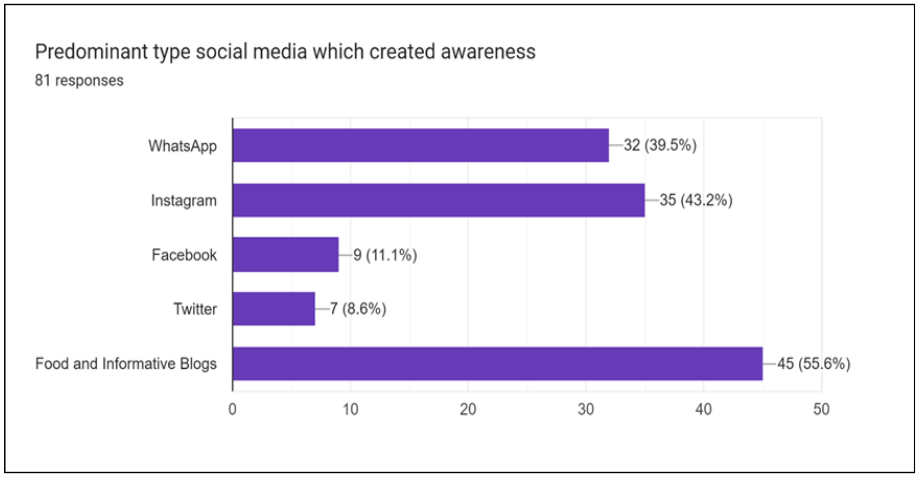

Fig. 4. Role of social media in millet awareness.

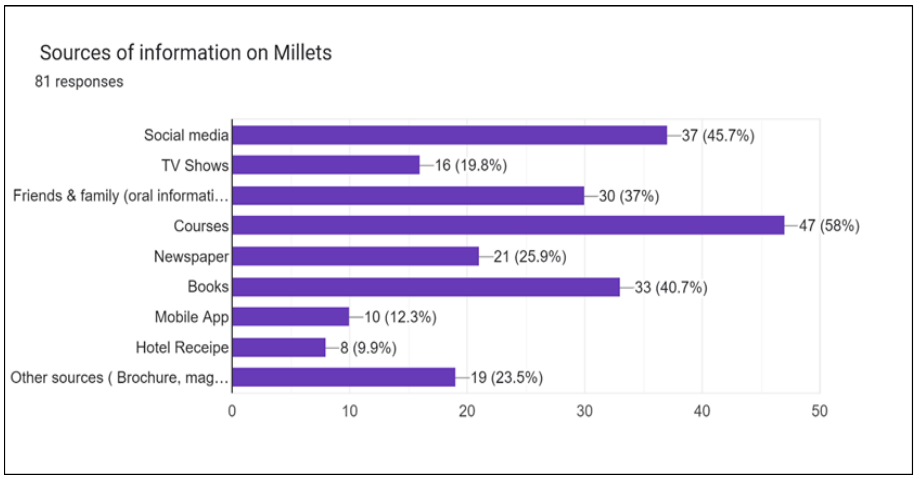

Fig. 5. Key sources of millet information.

awareness to establish millet as a mainstream staple food, promoting balanced nutrition and overall health. Among the respondents, 100 % confirmed that they consider millets to be healthy (Table 7).

Table 7. Respondents' perception of millets as a healthy food choice

Do you think millets are healthy	Yes	100 %
	No	0
	May be	0
	Don't know	0

Among those who consume millets, the study identified the primary reasons for their consumption. High iron content (72.8 %) and being good for diabetics (61.7 %) were the most frequently cited reasons, followed by high calcium content (56.8 %), benefits for women (55.6 %), good for pregnancy and beneficial for bone health. Additional reasons for millet consumption included benefits for babies (38.3 %), cancer (32.1 %) and other unspecified reasons (37 %). A majority of respondents indicated that they are highly health-conscious (Fig. 6).

Health conscious

When asked whether they believed millets were healthy, 69.1 % of respondents confirmed that they considered millets to be healthy (Table 8). The reasons for consumption are detailed in the table provided.

Table 8. Participants' health consciousness and attitudes towards well-being

		Frequency	Percent
Health conscious	Not at all	1	1.2
	Yes	56	69.1
	Maybe	24	29.6
	Total	81	100.0

Reasons for Consumption

Table 9 and Fig. 7 present the reasons for the consumption of millets. The predominant reason at the student level was the presence of health concerns. A combined 48.10 % of respondents indicated that health and fitness were the primary reasons for consuming millets. However, a few respondents mentioned that they ate millets simply because they were considered healthy; this trend was consistent across all students. This suggests that specific health issues are a more influential driver for millet consumption than the general perception that millets are healthy.

Among the respondents, more women attributed their consumption of millets to factors such as being served at home (8.6 %), enjoying the taste and the benefits for hair and skin (Table 10). In contrast, men tended to consume millets primarily because they were served at home. The least common reasons for eating millets were doctor's advice and the perception of longer satiety (1.2 %), which were associated with lower frequency of consumption. Furthermore, low-income

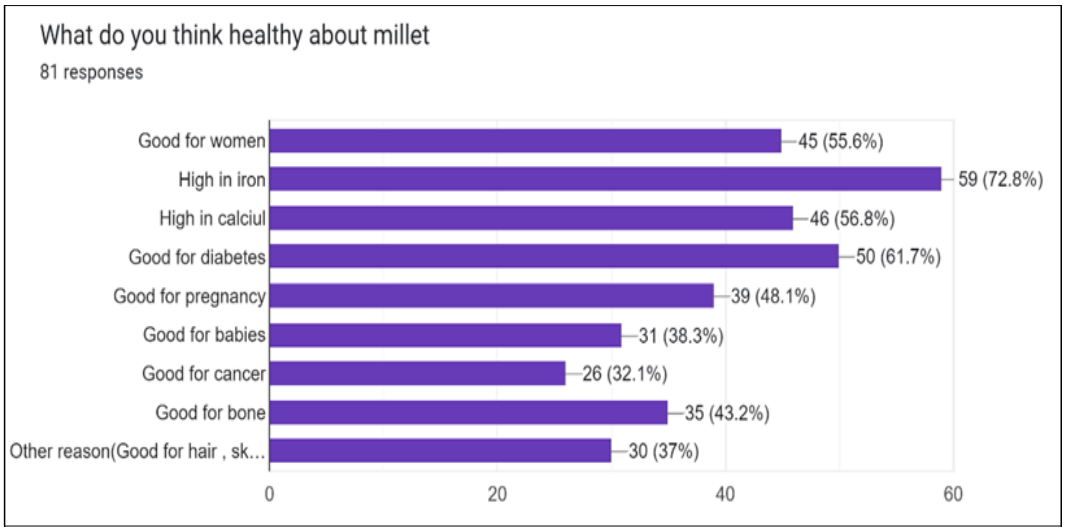

Fig. 6. Reasons behind respondents' millet consumption choices.

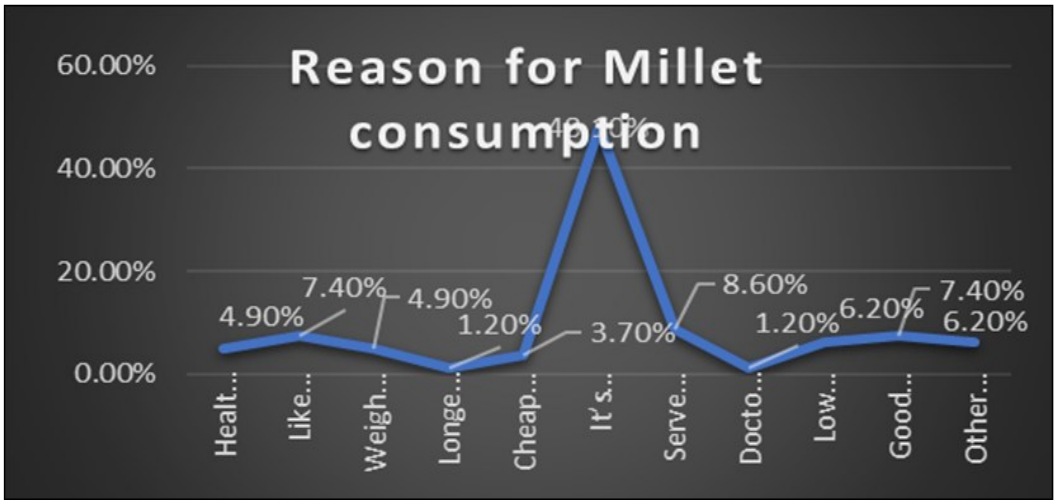

Fig. 7. Common consumption methods of millets among participants.

Table 9. Key reasons for millet consumption among participants

		Frequency	Percent
Reason for millet consumption	Cheaper	3	3.7
	Doctor advice	1	1.2
	Good for hair & skin	6	7.4
	Health problem	4	4.9
	It's health	39	48.1
	Like the taste	6	7.4
	Longer feeling fulness	1	1.2
	Low calorie	5	6.2
	Other reason	5	6.2
	Served at home	7	8.6
	Weight loss	4	4.9
	Total	81	100.0

Table 10. Millet consumption patterns among respondents

		Frequency	Percent
Consumption pattern of millet	Frequent (one or more times in a week)	23	28.4
	Moderate (once a month)	42	51.9
	Never or upto 2 times a year	4	4.9
	Regularly	12	14.8
	Total	81	100.0

respondents were more likely to consume millets because they found them affordable and enjoyed the taste.

Consumption pattern of millet

Although a significant proportion of consumers reported eating millets frequently (28.4 % consumed them once or more times per week), there was also a notable percentage who had either never consumed millets or only did so once or twice a year (4.9 %) (Table 11). Several factors contribute to the reduced consumption of millets such as millets may not be readily available in all markets, especially compared to rice and wheat., higher costs, lack of awareness and knowledge and taste.

Forms of millet consumption among students

The most common forms in which millets were consumed at the student level were dosa and ready-to-eat food, reported by 19.8 % and 17.3 % of the respondents, respectively. Breakfast, a traditional consumption form, was the most popular at 17.3 %. Additionally, 16 % of respondents stated that millet drink was the second most common form of millet consumption, following dosa (Table 12 and Fig. 8).

Diet preference

Among the sample respondents, the majority were non-vegetarians, comprising 54.3 % of the participants (Table 12).

Table 11. Popular consumption methods of millets among participants

		Frequency	Percent
How millets are eaten	Boiled like rice	6	7.4
	Breakfast	14	17.3
	Chapati & Roti	13	16.0
	Dosa	16	19.8
	Drink	13	16.0
	Rady to eat food	14	17.3
	Ready to cook food	5	6.2
	Total	81	100.0

Table 12. Participants' dietary Preferences

		Frequency	Percent
Diet Preference	Eggetarian	4	4.9
	Non-Vegetarian	44	54.3
	Vegetarian	33	40.7
	Total	81	100.0

Factors which inhibit the consumption of millet

Table 5 and Fig. 9 present the reasons for the infrequent consumption of millets. Surprisingly, students who did not frequently consume millets attributed this to factors such as a dislike of the taste, family customs, limited availability, high prices and long cooking times. Both low- and high-income groups exhibited similar tendencies.

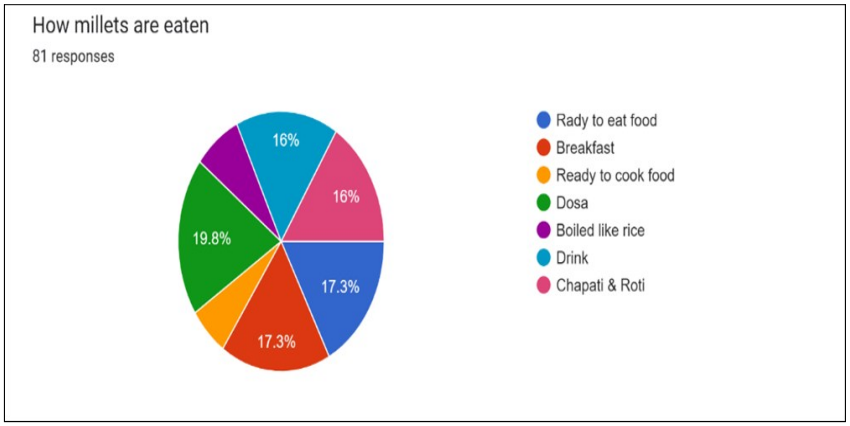

Fig. 8. Reasons for millet consumption among respondents.

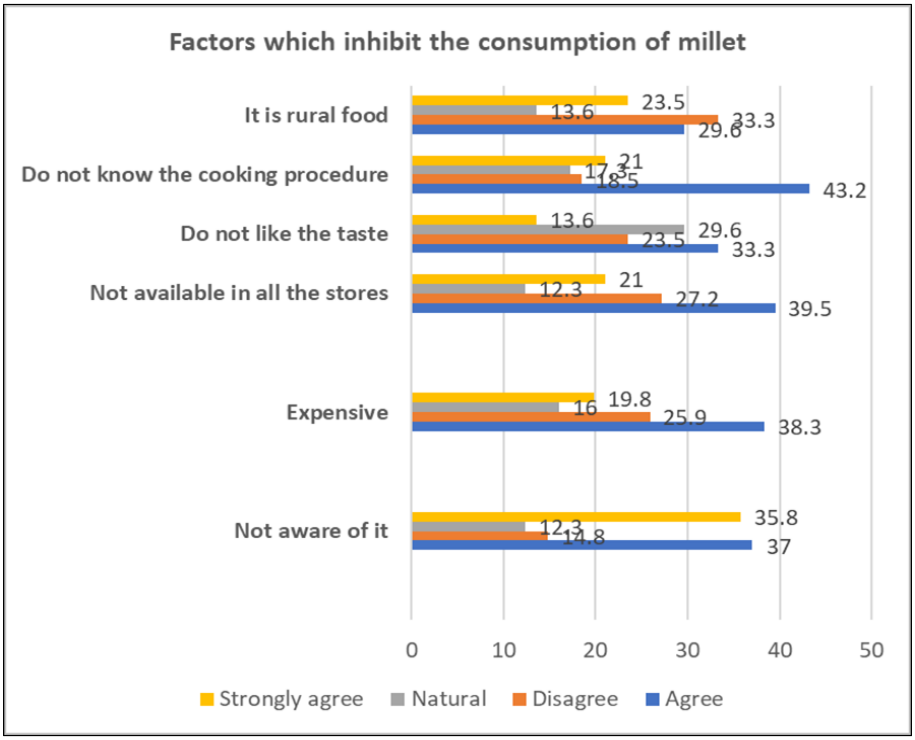

Fig. 9. Factors inhibiting the consumption of millets among participants.

Conclusion

The survey, involving 100 participants from agricultural, engineering and food nutrition and dietetics backgrounds, was narrowed down to 81 respondents after data cleaning. A key aim of this study was to assess the awareness and nutrient benefits of millets among students. The findings highlight that social media platforms are emerging as significant sources of information, playing a crucial role in increasing awareness about millets. The findings suggest a need to more actively promote the benefits of millets and to create awareness of various ways to cook millets or create millet products that cater to taste preferences, thereby changing the perception of millets and encouraging greater consumption.

Acknowledgements

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Authors' contributions

PP carried out the design of the study with necessary objectives developing the concept for the research, including its goals, structure, and approach. BS carried out analysis using software. MI & SA carried out the data collection procedure and formatting the data set. participated in the analysis using software. PJ and JA conceived of the study and coordinating the files.

Compliance with ethical standards

Conflict of interest: Authors do not have any conflict of interest to declare.

Ethical issues: None

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