

# Consumption Pattern of Millets among South Indian Adults

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## Abstract

Millets are the staple food for millions in Asian and several African countries. They are rich in dietary fiber, micronutrients, and beneficial phytochemicals. This study attempted to understand the consumption pattern of millets among south Indian adults in Chennai using a validated semi quantitative questionnaire which was administered telephonically. Purposive random sampling method was adopted for obtaining data from 100 millet consumers. The study results were analyzed using chi-square test, one-way analysis of variance, and correlation analysis. Equal percent of participants (41%) consumed millets 1-3 times a week and 1-3 times / month. Respondents considered millets nutritious and healthy as the main reason for consumption. Monthly income and family size significantly influenced frequency of consumption of millets. With reference to income groups, respondents belonging to income group >Rs. 50,000/month showed the highest percentage of frequency of consumption of millets, when compared to other income groups. Most consumers felt millets were affordable. *Kali* (stiff porridge/balls), *kanji* (porridge), *pongol*, *upma*, and biscuits were the most sought-after choices. Majority of the consumers combined other grains especially pulses in millet preparations such as *pongol* and *kichidi*. Finger millet preparations were the most commonly consumed millet-based preparation among all income groups or it could be concluded that consumers have a positive attitude toward millets for consumption and voiced the need for development of ready-to-cook and ready-to-eat value-added millet products such as millet *dosa* batter, noodles, flakes, breads, and millet-based beverages, for promoting consumers' health and fitness.

**Keywords:** Conveniences foods, drivers, frequency of consumption

## INTRODUCTION

Millets are ancient grains, which have traditionally been a part of Asian and African diets,<sup>[1]</sup> and are a source of complex carbohydrates, and nutritionally superior compared to white rice. However, green revolution and support prices extended to other staples such as rice and wheat have had a negative impact on millet cultivation and consumption in India. Millets are now referred to as neglected and underutilized Species. In India, eight millet species (sorghum, finger millet, foxtail millet, pearl millet, little millet, kodo millet, barnyard millet, and proso millet) are grown commonly under rain fed areas in semi-arid regions.<sup>[2]</sup> They provide high levels of dietary fiber and micronutrients. They contain good proportions

of calcium, iron, zinc, and potassium.<sup>[3]</sup> Millet proteins are poor sources of lysine and tryptophan but could be complemented with lysine-rich legumes and animal proteins for balancing the protein quality. Because of their unique phytochemical contents and aforementioned nutritional qualities, millets have been shown to have several health benefits.<sup>[4-7]</sup> Millets are known for their climate-resilient features and their diverse adaptation on marginal lands with lesser water requirement and lower susceptibility to environmental stresses. Thus, they

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deserve to be incorporated in daily diets for enhancing nutrition security as they are smart foods (<https://fpohub.com/wp-content/uploads/2021/06/2021-White-paper-on-millets.pdf> accessed on 23.3.23). Government of India renamed millets as “Nutri-cereals” through a Gazette Notification<sup>[8]</sup> and the year 2023 has been declared as the year of millets by the United Nations. Currently, millets are regaining their importance and several millet products are being sold in India.<sup>[9]</sup> It was found that most of the millets sold in India were highly polished and survey indicated that the lay public were unaware of the fact that some of the millets could be polished like rice.<sup>[10]</sup> In addition, this study also reported a high glycemic index (GI) index for both unpolished foxtail and little millet (plain pressure cooked). Indian diets are cereal staple based and white rice (nutritionally inferior) and wheat are the most commonly consumed staples and they provide the bulk of calories. Refined grain-based diets can increase the glycemic load of the diets and can increase the risk of non-communicable diseases. With the increasing prevalence of triple burden of malnutrition in India, a holistic approach would be a dietary modification—cereal staple correction (replacement of refined grains with whole grains, millets deserve a place as they are rich in dietary fiber and micronutrients) with inclusion of adequate levels of pulses, fruits and vegetables in the daily diet. In this context, the current study aimed to determine the consumption pattern of millets in south Indian adult millet consumers through a structured interviewer administered questionnaire.

## MATERIAL AND METHODS

The present quantitative research study was conducted in the cities of Chennai, Namakkal and Chidambaram

of Tamil Nadu during the year 2021. Respondents were selected through friends, relatives, neighbors. Randomized purposive sampling method was adopted for selection of 100 respondents who were millet consumers. Adults aged between 25 and 70 years were included in the study.

Pre-tested self-structured questionnaire that included closed and open-ended questions was used as an instrument to collect the data from respondents by personal telephonic interview method. The questionnaire was developed with questions about millets in relation to its frequency and mealtime consumption, reasons behind millet consumption, choice of millet-based preparations, and combination of millets with other grains in food preparations. Details on socioeconomic background were also included in questionnaire. The reliability and reproducibility of results were ensured by pre-testing the questionnaire with 20 subjects before the survey to validate and identify problems with the content and comprehensiveness of the questions, as well as other causes of (dis)satisfaction, which were added to the options sheet used by the interviewer. The face validity of the questionnaire was assessed with the inputs provided by the subject experts like scientists, nutritionists whereas the content validity was determined through the administration of questionnaire to participants before the commencement of study as discussed above. The overall study design is presented in Figure 1.

Standard descriptive statistics such as frequency, mean, median, and standard deviation were used to summarize the basic characteristics of the study participants. SPSS statistical software (version 16.0, SPSS Inc., Chicago, IL, USA) was used in this study to further analyzing the data.

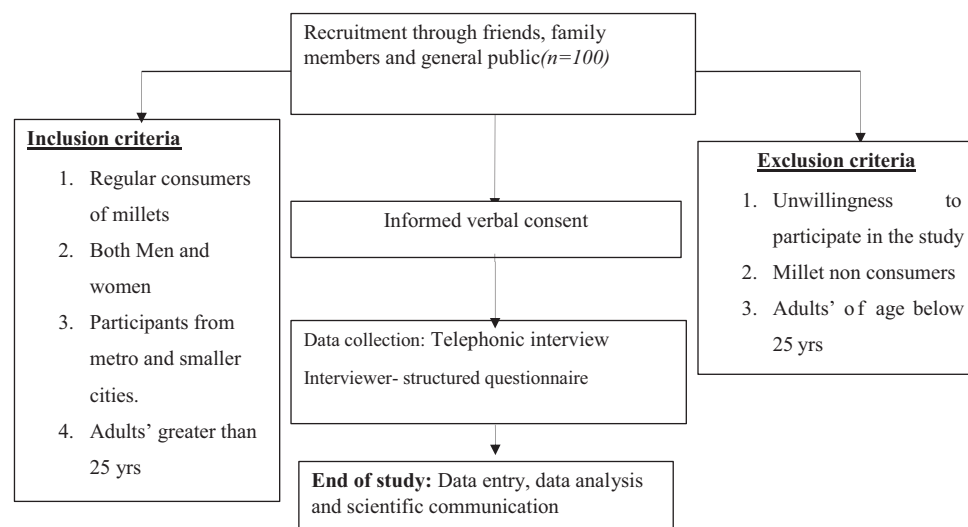


Figure 1: Overall study design

The current study reports on the consumption pattern of millets with reference to the influence of demographic factors among south Indian adults.

## RESULTS

### Demography of respondents

One hundred male and female respondents belonging to the age group of 25–70 years participated in the survey. Majority were women (55%) and the respondents were predominantly in the age group of 46–55 years (38%). There were 51 % in the normal weight category and 40% in the overweight category. Eight percent of the participants were in the income category of Rs 10,000–25,000 income per month, whereas 64% and 28% of the belonged to the income category of Rs 25,000, 50,000 per month and > Rs 50,000 per month categories, respectively. The respondents were predominantly Tamil speaking, Hindus, and with a bachelor's degree. Most of them were from a nuclear family. The summary of demographics is presented in Table 1.

### Frequency of millets consumption

An equal proportion of respondents consumed millet-based preparations 1–3 times/week (41%) and 1–3 times/month (41%). Only nine percent of respondents consumed millets

daily indicating lower level of respondents consuming millets on daily basis [Table 2]. Table 3 indicates that respondents from the age group of 25–35 years showed the highest frequency of consumption of millets and considerable proportion of respondents of higher age group (more than 55 years) consumed millets frequently Pearson's Chi-square test—showed that there was no significant association between gender and frequency of consumption of millets.

Pearson's Chi-square test showed that there was no significant association between gender and frequency of consumption of millets, between gender and reasons for consuming millets as well as mealtime and choice of common millet preparations ( $P > 0.05$ ).

From Table 2, it can be observed that maximum percent (48%) of respondents who consumed millet-based preparations (1–3 times per week) belonged to the income group >Rs. 50,000/month. The chi-square analysis showed that monthly income and family size had significant association with frequency of consumption of millets ( $P < 0.05$ ). It was observed that all income groups showed maximum frequency of consumption of millets at the rate of 1–3 times/week. Families with larger number of members consumed millets more frequently. The frequency of consumption was positively correlated to income of family and number of members of family.

**Table 1: Demographic profile of respondents (n = 100)**

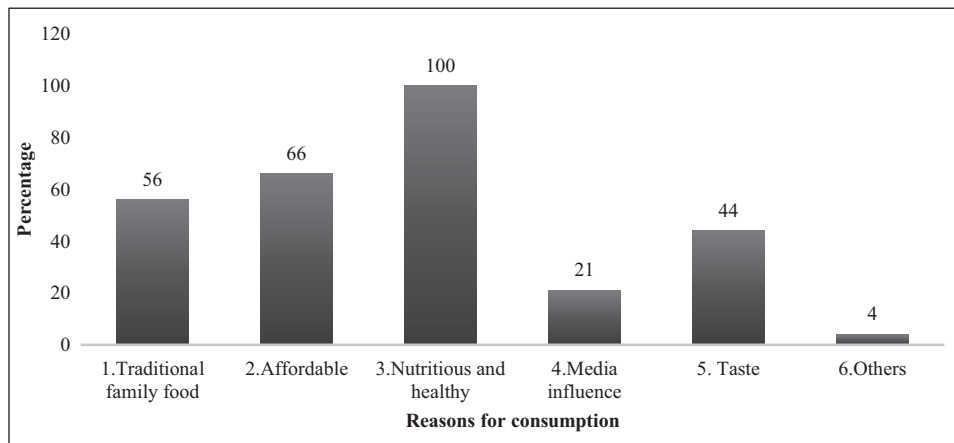
Items (n = 100)	Percentage	Items (n = 100)	Percentage
Age (years)		Occupation	
25–35	21	Professional/Executive/Manager/Business	39
36–45	14	Sales	1
46–55	38	Self employed	14
≥55	27	Housewife/Domestic work	38
Gender		Others	8
Male	45	Monthly income	
Female	55	>10,000–25,000	8
Mother tongue		>25,000–50,000	64
Tamil	66	>50,000	28
Telugu	26	Refused to answer/ Don't know	
Hindi	2	Family size	
Malayalam	3	≥7	10
Kannada	1	5-6	26
Others	2	≤4	64
Religion		Type of family	
Hindu	91	Joint family	37
Muslim	2	Nuclear family	63
Christian	7	BMI	
Education		Normal	51
Secondary school	9	Overweight	40
Higher secondary	15	Obese	9
Diploma/ITI	7		
Bachelor degree	45		
Post graduate degree	24		

**Table 2: Frequency of millet consumption among age groups, gender, income groups**

Frequency	Respondents %	25–35 years	36–45 years	46–55 years	≥55 years	Male %	Female %	>10,000–25,000 (Rs/month)	>25,000–50,000 (Rs/month)	>50,000 (Rs/month)
Daily	9	0	14.3	13.2	7.4	11.1	7.3	25	6.3	11.1
1–3 times/week	41	47.6	28.6	39.5	44.4	37.8	43.6	37.5	39.1	48.1
>3–6 times/week	6	0	14.3	7.9	3.7	6.7	5.5	0	3.1	14.8
1–3 times/month	41	52.4	42.9	39.5	33.3	42.2	40	12.5	50	25.9
Rarely	3	0	0	0	11.1	2.2	3.6	25	1.6	0

**Table 3: Choice of millet preparations stratified by sex, monthly income and BMI**

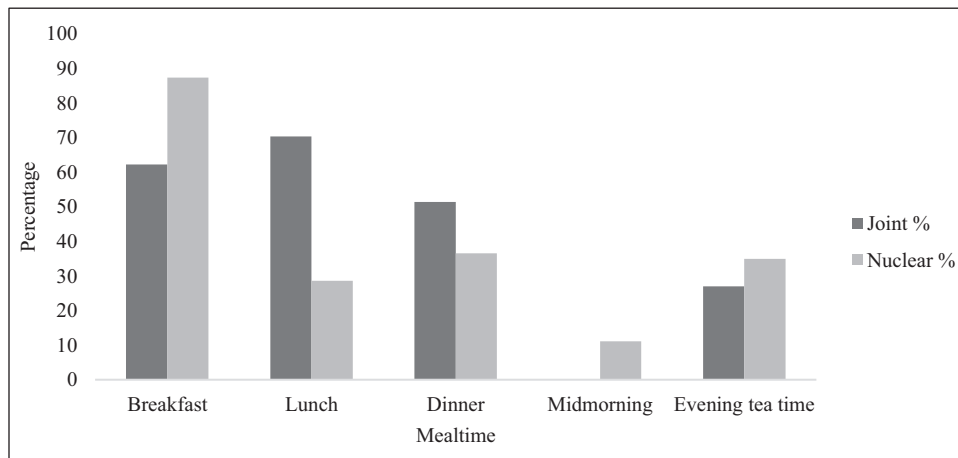
Commonly consumed millet preparations (home/outside)	No of respondents	Male %	Female %	Monthly income (Rs)			Body mass index (BMI)		
				>10,000–25,000	>25,000–50,000	>50,000	Normal%	Overweight %	Obese %
Plain cooked	28	31.1	25.5	25	20.3	48.1	21.6	27.5	66.7
Roti (Chapathi)	38	35.6	40	37.5	37.5	40.7	41.2	37.5	22.2
Porridge (Kanji)	72	68.9	74.5	100	78.1	48.1	74.5	72.5	55.6
Kalil Mudde	50	46.7	52.7	37.5	53.1	44.4	52.9	50	33.3
Upma	53	53.3	52.7	50	53.1	55.6	54.9	52.5	44.4
Idli	23	24.4	21.8	37.5	17.2	33.3	27.5	15	33.3
Dhokla	2	2.2	1.8	12.5	0	3.7	2	2.5	0
Vermicelli	46	44.4	47.3	37.5	45.3	48.1	47.1	42.5	55.6
Pongal	49	51.1	47.3	50	45.3	59.3	49	45	66.7
Kitchdi	36	37.8	34.5	37.5	29.7	51.9	35.3	30	66.7
Idiyappam/Sevai	21	20	21.8	12.5	28.1	7.4	29.4	12.5	11.1
Poha	13	11.1	14.5	12.5	7.8	25.9	9.8	17.5	11.1
Savories	22	24.4	20	37.5	18.8	25.9	27.5	15	22.2
Biscuits/crackers	39	40	38.2	62.5	34.4	44.4	39.2	40	33.3
Millet bread	10	8.9	10.9	12.5	6.3	18.5	13.7	7.5	0
Others, specify	25	22.2	27.3	-	-	-	-	-	-

**Figure 2: Reasons for consuming millets**

### Reasons for consuming millets

All the respondents considered millets as nutritious and healthy. Sixty six percent of the respondents felt millets were affordable for consumption especially those belonging to age group 36–45 years (78.6%), while 56% of the respondents felt millets were “traditional family food” and almost 44% of the respondents stated that millets were “tasty” [Figure 2].

In this study, it was observed that joint family mainly considered millets as tasty (51.4%) and as traditional food (59.5%) as reasons for consumption in comparison to nuclear family. Type of family was significantly associated with affordability as reason for consumption of millets. Nuclear family predominantly (74.6%) considered millets as affordable when compared to joint family (51.4%).



**Figure 3:** Mealtime, family type and millet consumption

### Mealtime and choice of millet preparations

Millets were preferably consumed during breakfast by most of the respondents (78%). However, 44% consumed millet during lunch and 42% respondents in dinner. Some of the respondents were consuming millet-based snacks along with evening tea. There was positive significant association between type of family and mealtime of consumption of millets (breakfast, lunch and evening snack time;  $P < 0.05$ ). It was also observed that nuclear families consumed millet-based food preparations in the breakfast (87.3%) whereas joint families consumed millets mostly during lunch (70.3%) and dinner (51.4%) [Figure 3].

The most sought-after choice of millet preparation was porridge/*kanji* (72%). Majority of the respondents also chose *upma* (53%), *kalimudde* (50%), *pongal* (49%), and vermicelli (46%) as common millet preparations. Millet *poha* (13%), millet bread (10%), and dhokla (2%) were less popular choices. Biscuits/crackers were consumed by 39% of the respondents as snacks. Chi-square analysis showed that family size was significantly associated with choice of common millet-based preparations like *roti*, *kali*, *porridge*, *upma*, vermicelli, *kitchidi*, *idiyappam*, biscuits/crackers, and millet breads ( $P < 0.05$ ). Families with larger number of members consumed these millet-based preparations. All the respondents belonging to the monthly income group >10,000–25,000 (Rs/month) consumed porridge (*kanji*) compared to income groups >25,000–50,000 and >50,000. With respect to body mass index (BMI) and consumption of millets, it was observed that plain cooked millets (66.7%), *pongal* (66.7%), *kitchadi* (66.7%), vermicelli (55.6%), porridge (55.6%), and *upma* (44.4%) were consumed more by respondents in the obese category. However, porridge, *upma*, *kali*, *pongal*, vermicelli, *roti*, and biscuits were more consumed by respondents in the normal BMI category. In the overweight category, porridge (72.5%) was most commonly consumed millet preparation.

**Table 4: Grains combined with millet for preparation and family members who consumed millets**

	Respondents Yes %
Grains combined with millet for preparation	
White rice	21
Brown rice	5
Whole wheat	19
Refined wheat	0
Refined cereal flours	0
Legumes and pulses	73
Split pulses	6
Gram flours	0
Others	4
Other family members who consume millets at home	
Parents	26
Spouse	75
In-laws	25
Grandparents	5
Children	81
Siblings	21
Others	1

### Combination of millets with other grains

It is of interest that majority (85%) of the respondent's combined millets with other grains such as legumes and pulses (73%), white rice (21%) and whole wheat (19%) in food preparations. Refined wheat, refined cereal flours and pulse flours were not combined with millets in food preparations. As per the Chi square analysis, there was significant association between monthly income and cooking millet with other grains. Monthly income and type of family had significant association with combining millet with brown rice for food preparations. Participants from nuclear family and from those belonging to >50,000/monthly income group combined millets with brown rice.

It was also observed that there is significant association between BMI and combination of millets with white rice

for food preparations (chi-square  $P < 0.05$ ). Under all the categories of respondents based on BMI, white rice was less preferred.

One survey revealed that the usual side dishes most commonly consumed with millet preparations were chutney varieties, sambar, curd, pickles, and vegetable curries. The study revealed that majority of the family members who consumed millets were the respondents' spouse (75%) and their children (81%) [Table 4].

## DISCUSSION

Changing consumer tastes and preferences, demographic, socio-economic, and other factors influence the consumption pattern of millets. Thus, it is imperative to understand the pattern of millet consumption in this population in order to understand perception on millets, the need, consumer awareness, preferences for different millets and millet-based preparations or products and barriers for millet consumption. This would aid in planning strategies to promote millet consumption in this population. As millets are being promoted by the government, there is a need to study the data on the consumption pattern of millets. In this regard the findings of this study sound the assumed significance. The key findings of this report are that millets were consumed mainly because they were considered to be nutritious and healthy, and that respondents felt millets were tastier and were affordable. The most sought-after choice of millet preparation among all age groups irrespective of income and family size was porridge. Thus, the study shows the importance of promoting such traditional food preparations with millets as convenience foods.

According to demographic profile of respondents, women and respondents from the age group of 25–35 years showed the highest frequency of consumption of millets. Gender had no influence on the reasons and frequency of consumption of millets, whereas monthly income did have a positive influence on the frequency of consumption of millets (respondents belonging to higher income group consumed millets frequently). With respect to reasons for consumption, all the respondents consumed millets for its nutritive value and health benefits. However, there are studies<sup>[11–13]</sup> which revealed that income, age and education have an influence on the consumption pattern of millets.

Millets were considered as nutritious and healthy by other studies as well, such observations were reported.<sup>[9,14]</sup> Development and popularization of healthier value-added millet-based convenience food products would be beneficial in improving the millet consumption. It is noteworthy that millets are consumed in joint families since it is considered to be a traditional food. The results of the 15,500 face-to face survey, coordinated by the International Crops Research Institute for the Semi-Arid Tropics showed that improving health and wellness,

weight loss and taste were the top reasons for those consuming millets in urban areas.<sup>[15]</sup> It is of interest that major mealtime option for millets was breakfast with the most common form of millet preparation being porridge which is a traditional food in India.

Millets have been consumed in different forms in different regions of India, among all the metro cities Ahmadabad and Bengaluru, had the largest consumption of millets in the form of ready-to-eat food.<sup>[9]</sup> Currently, in southern states of India, other common choices of millet preparations have been *kali* (millet balls), *upma*, and *idli*. Villages in karnataka, millets are consumed more commonly as plain cooked, *upma* and *paddu*, a fermented breakfast food,<sup>[16]</sup> whereas in Tamil Nadu, millet *porridge* and *koozh* are common.<sup>[17,18]</sup> The most commonly eaten forms of millets among the urban consumers are ready-to-eat products (46%) followed by porridge<sup>[15]</sup> and our study finding (porridge as the most preferred millet preparation) corroborates with the finding. Porridges have finer particle size flours, which are cooked in excess water, has highly gelatinized starch and are known to elicit higher glycemic responses as compared to grain-based preparations.<sup>[19]</sup> Given the increasing prevalence of diabetes in India and other NCDs in India, whole grain foods with lower GI are recommended.<sup>[20]</sup> Our previous studies have indicated higher GI for not only finger millet balls, a stiff porridge from millet but also for plain pressure cooked unpolished millets and rotis from jowar and bajra,<sup>[21]</sup> hence there is a need for porridge, roti mixes with lower glycemic properties and low GI options from millets for this population who are at risk for NCDs (Asian Indian Phenotype). Millet consumption in grain form with adequate amounts of pulses and vegetables to be encouraged as healthier meal option. Preparation of value-added products from millets (combining millets with ingredients rich in soluble fiber and pulses) can be helpful in preparation of products with lower glycemic properties.

There is also a need to understand the glycemic response of different millet meal options (including accompaniments) to impart dietary advice. Region wise millet consumption pattern evaluation across the country would throw light on the diverse culinary style, consumer preferences, which could help to understand the need for millet-based nutritious food products/preparations suitable for each region. This information would also enable nutritionists and food technologists to devise region specific healthy cooking methods using reformulation approaches for traditional foods by combining nutritious ingredients in the preparation and also to develop millet-based nutritious convenience products (with lower GI wherever possible).

The strength of the present study is the sample size it was conducted in 100 participants and that the study revealed growing demand for millet-based preparations in Chennai population, provides leads to food technologists

to develop millet-based foods. However, the study had its limitation as the survey got restricted to South Indian population living in the cities of Chennai, Chidambaram and Namakkal in Tamil Nadu, India. The study could have helped in devising better regional millet-based food choices if conducted in different regions in different states of India and more such studies are needed to popularize nutritious millets in Indian diets.

## CONCLUSIONS

This study shows that consumption of millets is largely influenced by the perception that millets are nutritious and healthy. Demographic factors like monthly income, family size and type of family had significant impact on the frequency of consumption and choice of millet-based preparations. The most commonly consumed millet preparations among south Indian adults in Tamil Nadu were porridge/*kanji* followed by upma, *kalimudde*, *Pongal*, and vermicelli. Millet preparations in combination with legumes and pulses were more common. The study findings reflect the consumer preference for legume-pulse based millet preparations and highlights the need for promoting such value-added foods in the society.

## Ethical clearance

Ethical approval for this study (Reg.No.ECR/194/Inst/TN/2013RR-19 (Registration number of Ethics Committee) was provided by the Ethical Committee of Institutional Ethics Committee of Madras Diabetes Research Foundation, Chennai 600086 on 24th August 2020.

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Nil.

## Conflicts of interest

There are no conflicts of interest.

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