

## Research Article

# A Study of Whole Grain Consumption Pattern along with its Determinants and Health Benefits in Various Students of Western Maharashtra, India

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## Abstract

**Introduction:** Whole-grains are very useful components of our daily diet. Whole grain consumption is associated with many health benefits. Whole grains also help in the maintenance of glucose, insulin homeostasis, lowering of serum Cholesterol and Low Density Lipoproteins Cholesterol concentration reducing inflammation and oxidative stress. Very few studies were done in Indian (Maharashtra) students, so in order to assess the whole-grain consumption and awareness about its importance in Indian student population we decided to conduct this study.

**Objectives:** The study was carried out to assess whole-grain intake pattern and factors influencing intake among Maharashtra students. The study also helped to reveal the awareness about whole-grains in Indian students.

**Methods:** A cross-sectional study investigating whole-grain intake was done among 331 students in Maharashtra. Validated questionnaire was given to assess various variables regarding knowledge and attitudes of the consumption of whole-grain. Data were analyzed using IBM SPSS software. Chi-square test was used.

**Results:** The prevalence of reported wholegrain consumption Everyday was only 15.7% (n=52), about 23.5% (n=78) ate whole grains more than 3 days a week, 22.6% (n=75) took less than 3 days a week and 38.3% (n=127) consumed only occasionally.

**Conclusion:** Very poor consumption of whole grains is done every day. In depth efforts are needed to narrow the knowledge-practice gap by assessing the barriers to whole-grain eating habits and to design effective initiatives to promote an increase in whole-grain consumption. Awareness and counselling among students is needed to spread information regarding the importance of consumption of whole grains in diet and its medical significance.

**Keywords:** Whole grain consumption; Students; India

## Introduction

Composition and components of a complete whole-grain, is cereal and pseudo-cereal which consists of endosperm, germ, and bran, where as a refined grain consists only of the endosperm [1]. Refining methods leads to loss of the components of whole-grains which render them the whole-grain status. Whole grain consumption has been associated with more nutrient intake and improved dietary quality which is necessary for healthy status of life [2,3]. Healthy dietary habits which include consumption of whole grains are associated with lower risk of many diseases and fulfil the need to lead a disease free life [4]. Whole grains are sources of multiple components which provide adequate quantities of carbohydrates, nutrients and fibre, in short whole grains may be considered as best food combination ever

as far as healthy dietary supplements is concerned [5-7]. Cereals are also important food components but Cereals lack essential amino acids, mainly lysine [8,9]. Whereas the proteins of the pseudo-cereals have a high nutritional contents [10,11]. Whole grain source include the list here [1-11]. Wheat, Rice, Barley, Maize, Rye, Oats, Millets, Sorghum, Triticale, Amaranth, Buckwheat, Wild Rice. Whole grains provide nutrients and fibres and are recommended to all in various proportions as mixture to meet daily nutrient needs in all age groups [5-7]. The fibre intake through whole grains has a very good impact on health status as far as flatulence problem is concerned. Consuming whole grains is associated with lower risk of several diseases, including coronary heart diseases, stroke, cancer and type II diabetes (T2DM) it also reduces LDL and Triglyceride levels (which is very beneficial against atherosclerosis), refined grains, are negative indicators in total cardiovascular health [4,12-15]. People who eat three servings per day of whole grain foods are having less chance to develop T2DM with a risk of reduction in the order of 20% to 30% [16].

Cereals contain substances like phytoestrogens and many phenolic acids which have antioxidant properties which help our body to deal effectively against oxidative stress. Processing reduces the content of these, whole grains also aid in the maintenance of glucose and insulin homeostasis, lowering of serum cholesterol and low density lipoproteins cholesterol concentration and reducing inflammation and oxidative stress [2]. Naturally cereals are very low in salt, but processed cereal foods are having more salt leading to hypertension. Their effects on gastrointestinal health, risk of obesity, CHD and cognition need further studies [17,18].

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Legumes have good qualities with whole grains and have potential benefit to glycaemic control including slow release carbohydrate and a high fibre content.

Increase in dietary intake of legumes as replacement food for high carbohydrate will induce glycaemic control and thus reduce incidence of diabetes. This is consistent with the various dietary intervention studies which have found improvements in glycaemic control after increasing the dietary intake of whole grain foods, legumes, vegetables and fruit. Mechanisms that help explain improvements in glycaemic control relate to cooking, type of starch, satiety and nutrient retention. Consumption of a wide range of carbohydrate foods from cereals, vegetables, legumes and fruits both for the general population and for people with diabetes [16].

As compared to UK and USA whole grains have been the major food source, Carbohydrates (60% to 70%) of the Indian population of the total food intake. Whole-grain foods are valuable sources of fibre, B complex vitamins, vitamin E, and Microelements like selenium, zinc, copper, and magnesium. They play important roles in disease prevention [19].

## Materials and Methods

### Study design

A cross sectional study was conducted among various students in Maharashtra, India from different streams of education including commerce, science and arts. Informed and Written consent was obtained from the students who volunteered to participate in the study by using Google forms. Confidentiality of the obtained information was maintained throughout the conduct of the study [20].

The sample size calculated using the Krejcie and Morgan's formula for a population of 331, the population proportion of 0.5, at a confidence level of 95% with an estimation error of 0.05 was 178 [21].

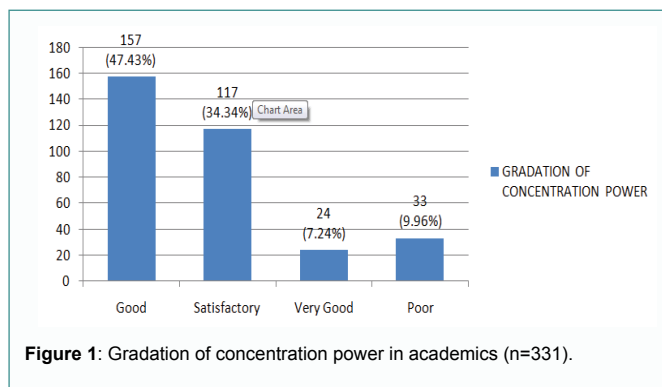


Figure 1: Gradation of concentration power in academics (n=331).

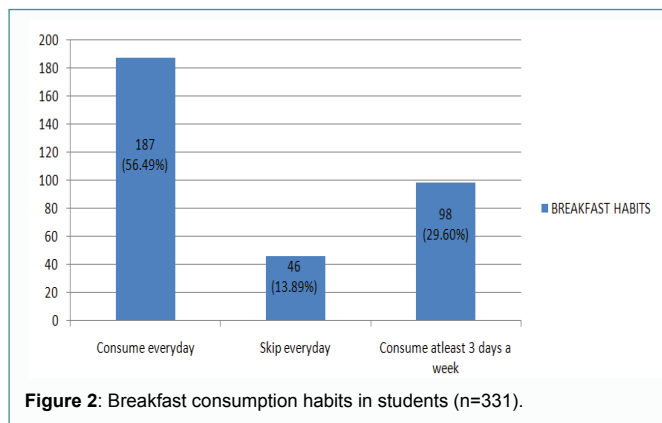


Figure 2: Breakfast consumption habits in students (n=331).

### Operational definitions

- Whole-grain consumers defined as respondents who took whole grains everyday or more than 3 days a week.
- Whole-grain skippers defined as the respondents who took breakfast less than 3 days a week and those who had occasionally.

### Study instrument

We used a self-administered questionnaire comprising three sections. The questionnaire was circulated online using Google forms to ensure the completeness of the information [22].

**Section 1:** Included information on socio demographic variables such as age, gender, ethnicity, and year of study, parents' level of education, monthly household income, and living arrangement. Information about height, weight was obtained and on that basis BMI was calculated. Information regarding allergies, health issues was obtained.

**Section 2:** Comprised information with relation to breakfast, lunch and dinner related habits, dietary habits, it's patterns and questions pertaining to assessing the students' knowledge ( both perceptual and actual), and attitude toward whole grains consumption. Problems such as flatulence, heart burning (acidity), constipation were also accessed.

**Section 3:** Based on Counselling, how likely were they to include whole grains in their diet.

### Statistical analysis

The BMI was calculated as weight in kilogram divided by height in square metres ( $\text{kg}/\text{m}^2$ ). Based on World Health Organization (WHO), BMI standards for Asian population, a BMI of less than 18.5  $\text{kg}/\text{m}^2$  was considered as underweight, 18.5  $\text{kg}/\text{m}^2$  to 22.9  $\text{kg}/\text{m}^2$  as the normal range, 23.00  $\text{kg}/\text{m}^2$  to 27.4  $\text{kg}/\text{m}^2$  as pre obese, 27.5  $\text{kg}/\text{m}^2$  or more as obese. Data was assessed using the Chi Square Test. A p-value of less than 0.05 was considered statistically significant [2,23].

## Results

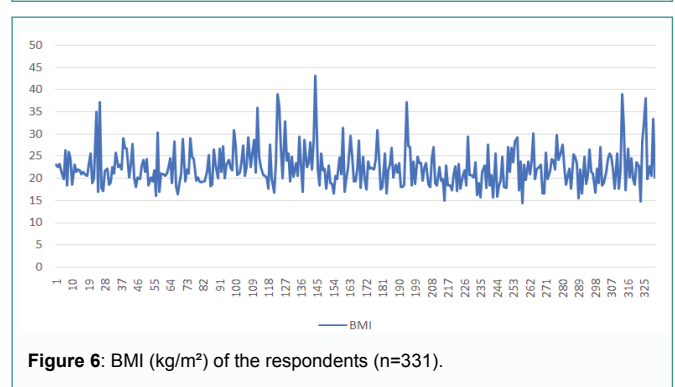
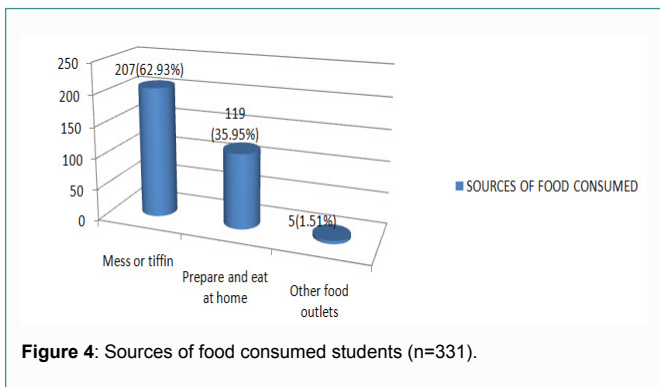
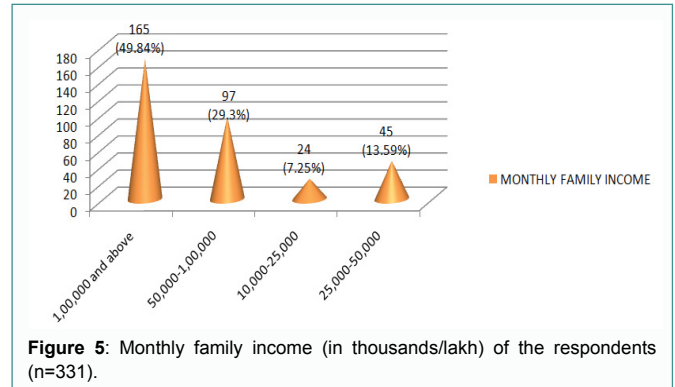
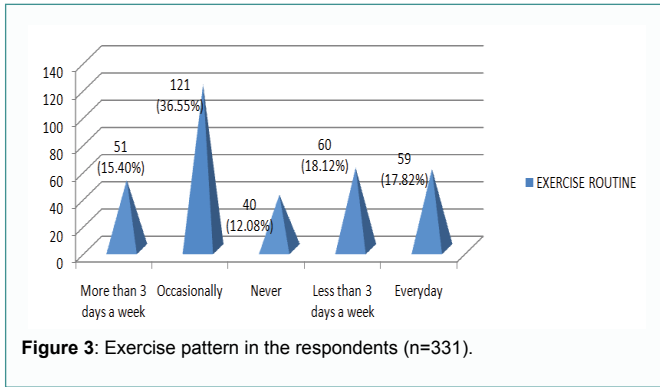
### Socio-demographic characteristics

All of the 331 respondents were the students in the age group of 17-24 years with 62.3% (n=207) females and 37.6% (n=125) males. All Students were native of Maharashtra state, of which majority were from Rest of Maharashtra 78.9% (n=262), followed by Marathwada region 12.04% (n=40) and Vidharbha region 9.03% (n=30). 76.51% (n=254) students were of medical field, 12.65% (n=42) students of engineering and remaining 10.84% (n=36) students were of other fields. About 30.4% (n=101) of the participants mothers and 38.9% (n=129) of the participants father had attained post-graduate education. 49.7% (n=165) participants reported that their monthly household income was above 100,000 (INR) 29.2% (n=97) reported it as 50,000-100,000 (INR). Of all respondents 52.4% (n=154) were hostelites, 34.00% (n=113) were Day scholar and remaining 13.6% (n=45) were paying guests/living in flats.

### Wholegrain consumption and its pattern

**For breakfast:** The prevalence of reported wholegrain consumption everyday was only 15.7% (n=52), about 23.5% (n=78) ate wholegrain more than 3 days a week, 22.6% (n=75) took less than 3 days a week and 38.3% (n=127) consumed only occasionally.

**For lunch and dinner:** The prevalence of reported wholegrain consumption. Every-day was only 39.5% (n=131), about 33.4%



(n=110) are wholegrain more than 3 days a week, 15.7% (n=52) took less than 3 days a week and 11.4% (n=38) consumed only occasionally. Assessment of the type of whole grain consumed. Showed that wheat was consumed on large scale, 96.4% (n=320) in lunch and 88.9% (n=295) in dinner, whereas Jowar (Sorghum) was consumed by 3.6% (n=12) in lunch and 8.7% (n=29) in dinner and Bajara (Millet) was consumed only at night by 2.4% (n=08) respondents. It was also recorded that majority 97.8% (n=324) respondents consumed white rice and only 2.2% (n=08) consumed brown rice [24,25].

**Determinants of whole grain consumption**

Table 1 shows the various factors considered in this study regarding whole grain consumption. Breakfast habits ( $X^2= 35.545, p<0.05$ ) were found to be significantly related to whole grain consumption. Regular breakfast consumers who ate breakfast everyday were found to eat higher amount whole grains in their diet than those who ate occasionally or skipped breakfast for at least 3 days a week.

**Considering the behavioural determinants**

It was found that the students had good nutritional knowledge and were willing to include wholegrain in their diet (83.7%). The finding of the present study was different to those in study conducted by de Almeida et al. [26] which suggested that nutritional knowledge and good dietary habits are not strongly correlated.

A significant proportion of the respondents in this study who reported that they adhere to the food groups in the Maharashtrian pyramid were more likely to be wholegrain consumers. In this study, it was found to have a significantly positive attitude among majority of them who did not consume whole grains at present and expressed their willingness to include wholegrains in their regular diet (83.7%).

**Discussion**

The prevalence of wholegrain consumption among students of Maharashtra was 39.2% in breakfast and 72.9% in lunch and

dinner, which is different compared to prevalence (51%), reported in a Malaysian study [20]. Apart from this, a study conducted by Nisar et al. [21] reported a higher prevalence (51%) of whole grain consumption among medical students in Karachi. Another study conducted by Rose et al. [22] reported that 86% of the students at the University of Nebraska consumed whole grains which are high as compared to our results. Overall consumption of whole grains in the US population was low using the recently updated whole-grain definition. Adults who consumed the most servings of whole grains had better diet quality and nutrient intakes [2]. The main sources of wholegrain were wheat, bajra (Millet), jowar (Sorghum) and rice, which is easily available as local food in Maharashtra.

**Considering the economic determinants**

The consumption of food depends largely on the cost of food where its affordability is governed by the socio-economic status of the consumer.

**Relationship between accessibility & consumption**

The economic status of the respondents was evaluated based upon the monthly household income, which did not seem to influence the whole grain consumption pattern of the respondents in the study. The students had easy accessibility to various food outlets and Tiffin services or super markets and despite being from diverse economic backgrounds no relation between income and whole grain consumption could be drawn.

**Considering physical determinants**

**Education [self/parental]:** Kearney et al. [23] proved that the dietary pattern in adulthood is influenced by level of education. The study considered students from various courses like Medicine, Engineering, Commerce and others. It was seen that the level of self or parental education did not influence the practice of wholegrain consumption.

**Table 1:** Socio demographic factors influencing whole grain consumption.

Sock.- demographic characteristics		Whole grain consumption in breakfast Eat occasionally	Less than 3 days a week	More than 3 days a week	Consume everyday	$\chi^2$	P values
Gender	Male	23 (35.9)	15 (23.4)	19 (29.7)	7 (10.9)	2.095	0.553
	Female	45 (39.5)	25 (21.9)	25 (21.9)	19 (16.7)		
Native place	Rest of Maharashtra	54 (36)	36 (24)	41 (27.3)	19 (12.7)	8.198	0.224
	Vidharbha	4 (40)	2 (20)	1 (10)	3 (30)		
	Marathwada	10 (55.6)	2 (11.1)	2 (11.1)	4 (15.4)		
Courses	Medicine	58 (40.8)	32 (22.5)	34 (23.9)	18 (12.7)	10.751	0.293
	Engineering	6 (31.6)	6 (31.6)	5 (26.3)	2 (10.5)		
	Commerce	0 (0.00)	1 (25)	1 (25)	2 (50)		
	Other	4 (30.8)	1 (7.7)	4 (30.8)	4 (30.8)		
Mother's Education	Under Graduate	17 (42.5)	6 (15)	8 (20)	9 (22.5)	5.895	0.435
	Graduate	31 (39.6)	18 (21.4)	23 (27.4)	12 (14.3)		
	Post Graduate	20 (37.0)	16 (29.6)	13 (24.1)	5 (9.3)		
Father's Education	Under Graduate	7 (29.6)	6 (23.1)	6 (23.1)	7 (26.9)	5.215	0.517
	Graduate	31 (38.3)	17 (21)	21 (25.9)	12 (14.8)		
	Post Graduate	30 (42.3)	17 (23.9)	17 (23.9)	7 (9.9)		
Living arrangement	Hostelite	47 (39.4)	21 (22.3)	25 (26.6)	11 (11.7)	4.015	0.675
	LOallte	22 (33.8)	17 (26.2)	14 (21.5)	12 (18.5)		
	Paying Guest/Flat	9 (47.4)	2 (10.5)	5 (26.3)	3 (15.8)		
Monthly household income	10,000-25000	4 (40)	1 (10)	2 (20)	3 (30)	4.935	0.84
	25,000-50000	7 (30.4)	5 (21.7)	6 (26.1)	5 (21.7)		
	50,000-1,00,000	21 (38.9)	11 (20.4)	14 (25.9)	8 (14.8)		
	1,00,000 and above	36 (39.6)	23 (25.3)	22 (24.2)	10 (11.10)		
Body Mass Index	Underweight	10 (34.5)	6 (20.7)	8 (27.6)	5 (17.2)	7.632	0.572
	Normal	29 (35.8)	16 (19.8)	22 (27.2)	14 (17.3)		
	Pre- obese	20 (45.5)	9 (20.5)	11 (25)	4 (9)		
	Obese	9 (39.1)	9 (39.1)	3 (13)	2 (8.7)		
Breakfast habits	Eat occasionally	23 (79.3)	2 (6.9)	1 (3.4)	3 (10.3)	35.545	0
	Consume at least 3 times a week	18 (36.7)	17 (34.7)	8 (16.3)	6 (12.2)		
	Consume everyday	27 (27)	21 (21)	35 (35)	17 (17)		
Source of breakfast consumed	Prepare and eat at home	23 (37.7)	12 (19.7)	14 (23)	12 (19.7)	3.919	0.688
	Mess / Tiffin	44 (38.6)	28 (24.6)	29 (25.4)	13 (11.4)		
	Outside	1 (33.3)	0	1 (33.3)	1 (33.3)		

**Table 2:** Behavioral determinants of whole grain consumption in lunch/dinner.

Attitude toward whole grain consumption		Whole grain consumption in lunch / dinner Eat occasionally	Less than 3 times a week	More than 3 times a week	Everyday	$\chi^2$ (Chi Square)	P values
How likely are you to include more whole grain in your diet?	Not Likely	10 (31.3)	4 (12.5)	8 (25)	10 (31.3)	9.659	0.022
	Very Likely	15 (10.3)	26 (17.8)	43 (29.5)	62 (42.5)		
How likely are you to encourage your family members to include whole grains in your regular meals?	Not Likely	5 (20.8)	6 (25)	6 (25)	7 (29.2)	3.005	0.391
	Very Likely	20 (13)	24 (15.6)	45 (29.2)	65 (42.2)		

**Table 3:** Behavioral determinants of whole grain consumption in breakfast.

Attitude toward whole grain consumption		Whole grain consumption In breakfast Eat occasionally	Less than 3 times a week	More than 3 times a week	Everyday	$\chi^2$ (Chi square)	P
How likely are you to include more whole grain in your diet?	Not likely	16 (50)	4 (12.5)	9 (28.1)	3 (9.4)	4.062	0.255
	Very likely	52 (35.6)	36 (24.7)	35 (24)	23 (15.8)		
How likely are you to encourage your family members to include whole grains in your regular meals?	Not likely	13 (54.2)	6 (25)	4 (16.7)	1 (4.2)	4.724	0.193
	Very likely	55 (35.7)	34 (22.1)	40 (26)	25 (16.2)		

Sources of food, cooking skills, method involved and preparation time are important physical determinants of food taken. Our study showed that the respondents who prepared and had food at home (62.7%) were more likely to consume whole grains. Lappalainen et al. [24] reported lack of time as a frequent attitude of not following nutritional advice, particularly by the young and educated class.

**Social determinants:** Although whole grains constitute a major part of agricultural crops in Maharashtra, no significant relationship between whole grain consumption and the socio-cultural background could be drawn in our study. A study showed that social factors impact an individuals or groups eating behaviour directly [buying food]

or indirectly [learning from peer's behaviour] either consciously or subconsciously. Family has substantial influence in shaping an individual's eating habits [24]. Our study on the other hand showed no significant relation between living arrangements [Hostelite, Day scholar, flat/Paying Guest (PG)] and wholegrain consumption attitudes [26,27].

## Conclusion

The study revealed that though the majority of the students were whole grain consumers, and only small percentage consumed wholegrains daily. Even though there are many factors that influence the food choice, a striking influence of ethnic background, cooking

skills and method, self-perception to adhere to food groups in the Maharashtrian food pyramid was found.

Finally, dynamic approaches need to be formulated that would encourage the students to have regular whole grains in their food and lead a healthier life. In order to achieve this goal, approach needs to be adopted right from early primary school to include whole grains as an important component of nutrition and its basic knowledge and health benefits should be emphasized. However, more detailed studies are needed to be conducted to investigate the biological, psychological, and hindering factors that influence whole-grain consumption among students. More Researches is to be conducted on same basis in various regions in the world and people need to be made aware regarding healthy dietary intake as the world to is facing large number of health problems due to poor dietary intake.

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