Nutritional Assessment Among Young Adults of North India

Kirtan Rana[1], Atul Gupta[2], Praizy Bhandhari[3]

[1]Department of Community Medicine, [2]Department of Health, [3]Department of Community Medicine,
[1]Maharishi Markandeshwar Medical College and Hospital, Maharishi Markandeshwar University, Solan, India.
[2]Depatment of Health, Mandi, Himachal Pradesh
[3]Gian Sagar Medical College and Hospital, Baba Fareed University of Health Sciences, Patiala, India

Corresponding Author: Atul Gupta

ABSTRACT

The food intake is highly influenced by numerous factors especially among adolescents and young adults. The current study assessed the macro- and micronutrient intake of college students in Chandigarh, North India. A Population based, cross sectional study was conducted among 420 college students, data were collected on demographic and food habits and assessed using Dietcal software. Frequencies, percentages, T test and Mann Whitney U test were used of statistical analysis The average intake of total calories per day was 1552.9 ± 322.2 Kcal. There was statistically significant difference in the mean calorie (female: 1453.8 ± 338; male 1702 ± 311.4), mean fat (female: 35.67 ± 12.1; male 41.43 ± 12.4) and median protein consumption (female: 45.8 (40.1-49.8); male 53.4 (49.2-58.9), vitamin B3, B6 and E among study participants. The study concluded that micronutrients were found deficient and macronutrients were found in excess in the food taken by the college students.

Keywords: College students, Food, Macronutrient, Micronutrient, Nutrient deficiency

INTRODUCTION

The food industry has changed the concept of food in modern times, from an essential commodity to a status symbol for many. The adolescents and young adults are influenced by the appearance of food rather the nutritive value of food, especially.[1] The compromises in the quality of food in critical group presents either as non-communicable diseases or some kind of deficiency diseases, impacting their physiological functioning in long run.[2,3]

Various factor such as living away from home, time constraints, living in a hostel, peer pressure, skipping meals, consuming large portion sizes and having lower intake of vegetables and fruits has been found to alter the eating habits of college students.[4] There has also been a documented increase in sugar, fat and alcohol consumption, and a decline in fruit and vegetable intake among this group of population, which are risk factors of non-communicable disease, thus adding burden to the magnitude of non-communicable diseases.[5–8]

A balanced diet is essential for the optimum functioning of the body.[9] Though our body requires only trace amounts of micronutrients, a lack of any one of them can, however, result in serious and even life-threatening illnesses.[10] The most prevalent nutritional deficiencies worldwide are those of iron, calcium, vitamin A, and iodine and are highly prevalent in low- and

middle-income countries making people dependent on micronutrient supplements to cover up the deficit but pushing them into impoverishment owing to the high cost of these supplements.[11,12] India vouched for millets, owing to its benefits, in a meeting in the United Nations General Assembly in 2021, and at the behest of the Indian government the year 2023 was declared as the International Year of Millets.[13]

This current study assessed the macronutrient and micronutrient intake status of college students in North India.

MATERIALS & METHODS

A cross-sectional study was conducted in North India to assess the macro- and micronutrient consumption of college students. The data was collected from Sept 2020 to January 2021. Using the formula $4pq/r^2$, where P= 53.1% is the prevalence of anaemia, r= 0.05 (absolute precision) at 95% confidence interval,[5] A sample size of 383 was calculated, and adding 10% non-response rate, the final sample size came to around 420 (approx.).

Sampling technique: Multistage sampling technique was used. In first stage, one college was chosen out of all the colleges in Chandigarh using lottery method. In second stage, simple random method was used to enrol study participants fulfilling the inclusion criteria (sampling frame). All college students between the ages of 18-21 years in the selected college were included.

Methods: After the permission of the higher authority of the college the participants were briefed about the objectives of the study. The students willing to enrol were asked about demographic characteristics (age, gender, residence, monthly income, type of family, religion, and social caste), anthropometry (height, weight, waist, hip), and dietary history according to 24 hr recall method was collected using Epicollect 5 software.

The diet taken by the participants was entered into Dietcal software- a tool for dietary assessment and planning, to calculate the macro- and micronutrient content of the food consumed by the participants.

Confidentiality of the participants and their data was ensured, and the access to the data was granted only to the authors of the study. The study was conducted after taking ethical approval from the institute (INT/IEC/2018/2018/001437).

STATISTICAL ANALYSIS

The data was retrieved from the Epicollect5 software and exported into Microsoft Excel 2016. The data was analysed in Statistical Software for Social Sciences (SPSS) v 24. The data was checked for its normal distribution. The continuous data was presented as frequencies, percentages, mean, standard deviation, median, and interquartile range depending upon the distribution of the data (normal or skewed). The discrete data and categorical data were presented as frequencies and percentages. T test was used to compare the means, while the Mann Whitney U test was used for the comparison of medians between two groups. All values were calculated using a 95% confidence interval, and p value of 0.05 (two tailed) was taken to consider the result statistically significant.

RESULT

The majority of the participants in our study were males (59.3%), participants belonging to age 20 years (30%), participants having normal BMI (50.5%), participants having WHR at risk (78.8%), high health risk based on WHR (38.1), residing in urban areas (67.4%), living off campus (76.7%), residing in nuclear family (61%), belonging to Hindu religion (86.2%) and general social caste (82.6%) as presented in Table 1.

Table 1: Demographic characteristics of study participants (N=420)

Characteristics	N (%)
Gender	
Male	249 (59.3)
Female	171 (40.7)
Age	
18	86 (20.5)
19	122 (29)
20	126 (30)
21	86 (20.5)
BMI	
Underweight	53 (12.6)
Normal	212 (50.5)
Overweight	64 (15.2)
Obese 1	86 (20.5)
Obese 2	5 (1.2)
WHR	
Normal	89 (21.2)
Risk	331 (78.8)
Health risk based on WHR	
Low	250 (59.5)
Moderate	10 (2.4)
High	160 (38.1)
Monthly income (Rs)	
>185,895	14 (3.3)
92951-185894	113 (26.9)
69535-92950	151 (36)
46475-69534	94 (22.4)
<46475	48 (11.4)
Residence	
Rural	137 (32.6)
Urban	283 (67.4)
Present residence	
Off Campus	322 (76.7)
In Campus	98 (23.2)
Type of family	
Joint	164 (39)
Nuclear	256 (61)
Religion	
Hindu	362 (86.2)
Sikh	47 (11.2)
Muslim	9 (2.1)
Buddhist	1 (0.2)
Others	1 (0.2)
Social Caste	
General	347 (82.6)
OBC	37 (8.8)
SC	28 (6.7)
ST	8 (1.9)

The mean age of participants was 19.5 ± 1.0 years. The mean intake of total calories was 1577.5 ± 324.8, while that of fat was 38.55 ± 12.3 grams. The median intake of carbohydrates was 277 (218.1-298.7) grams and protein was 51.7 (41.1-59.8) grams. The mean and median intake of different vitamins and essential minerals is presented in Table 2.

Table 2: Mean and Median of demographic and nutritional parameters among study participants

Parameters	Mean ± SD	Median (IQR)
Age	19.5 ± 1.0	-
BMI	-	21.8 (19.5-24.3)
Monthly income	-	50000 (40000-75000)
Moisture	-	94.1 (70.1-126.8)
Protein	-	53.2 (50-59.5)
Fat	41.9 ± 12.3	-
Carbs	-	277 (218.1-298.7)
Kcal	1552.9 ± 322.2	-
Vit. B1	0.58 ± 0.24	-
Vit. B2	-	0.32 (0.24-0.54)
Vit. B3	5.2 ± 1.7	-
Vit. B5	-	1.9 (1.5-2.4)
Vit. B6	0.52 ± 0.22	-
Vit. B9	80.6 ± 43.9	-
Vit. E	-	0.7 (0.5-1.3)
Vit. A	-	1545.9 (1157.1-2108.3)
Vit. C	-	54.1 (37-124.7)
Ca	-	385.54 (231.7-815.8)
Cu	-	0.93 (0.76-1.16)
Fe	-	8.2 (6.5-9.9)
Mg	-	205.6 (176.8-245.3)
Se	81.1 ± 24.5	-

A statistically significant difference in mean ± SD intake of kilo calories (females vs males: 1453.8 ± 338.3 vs 1702 ± 311.4, p value 0.01), fat (females vs males: 35.67 ± 12.1 vs 41.43 ± 12.4, p value 0.001), vitamin B3 (females vs males: 5.04 ± 1.6 vs 5.45 ± 1.7, p value 0.01) and vitamin B6 (females vs males: 0.49 ± 0.21 vs 0.54 ± 0.23, p value 0.03) was found among study participants as presented in Table 3.

Table 3: Mean difference of nutritional parameters between females and males in the study population

parameters	Female	Male	Mean difference	95% CI, P value
Age	19.45 (1.02)	19.53 (1.04	-0.08	-0.28 - 0.12, 0.42
Kcal	1553.59 (338.3)	1552.4 (311.4)	1.14	-61.83 - 64.13, 0.97
Fat	42.67 (12.1)	41.43 (12.4)	1.23	-1.17 - 3.65, 0.31
Vit. B1	0.58 (0.23)	0.59 (0.25)	-0.01	-0.05 - 0.04, 0.82
Vit. B3	5.04 (1.6)	5.45 (1.7)	-0.41	-0.74 – (-0.07), 0.01
Vit. B6	0.49 (0.21)	0.54 (0.23)	-0.05	-0.9 – (-0.003), 0.03
Vit. B9	77.2 (42.2)	83.0 (45.0)	-5.78	-14.36 - 2.79, 0.18
Se	79.9 (23.2)	81.9 (25.3)	-1.93	-6.72 - 2.85, 0.42

There was no statistically significant difference in the median (IQR) intake of carbohydrates (females vs males: 237.4 (221.3-299.9) vs 279.5 (217.9-298.7), p value 0.81) but statistical difference in median (IQR) proteins intake (females vs males: 45.8 (40.1-49.8) vs 53.4 (49.2-58.9), p value 0.01). A statistically significant median difference in the median (IQR) intake of Vitamin E (females vs males: 0.62 (0.49-1.1) vs 0.75 (0.53-1.3), p value 0.02) was found among daily intake of females and males as presented in Table 4.

Table 4: Comparing nutritional parameters between males and females in the study population

Parameters	Median (IQR)		Mann-Whitney U test	P value
	Female	Male		
Moisture	94.4 (68.9-125.5)	94.6 (70.3-127.5)	20624.5	0.58
Protein	53.2 (49.9-59.3)	53.3 (50-60.1)	20301.5	0.41
Carbohydrates	237.4 (221.3-299.9)	279.5 (217.9-298.7)	21009.5	0.81
Vit. B2	0.30 (0.23-0.53)	0.34 (0.24-0.55)	19672.5	0.18
Vit. B5	1.92 (1.5-2.4)	1.8 (1.5-2.4)	20997	0.81
Vit. E	0.62 (0.49-1.1)	0.75 (0.53-1.3)	18411.5	0.02
Vit. A	1561.7 (1115.4-2133.2)	1544 (1183.6-2108.1)	20872.5	0.73
Ca	401.7 (234.2-868.5)	373.4 (229.7-761.9)	19754	0.21
Cu	0.92 (0.77-1.1)	0.93 (0.75-1.17)	20734	0.65
Fe	8.42 (6.6-10.1)	8.15 (6.51-9.87)	20598	0.57
Mg	205.6 (176.4-240.5)	209.2 (177.2-247.1)	20327	0.43
Vit. C	49 (36.9-123.9)	59.9 (37-127)	20643.5	0.59

DISCUSSION

An optimum quantity of macronutrients and micronutrients is essential for sustaining a healthy life. The current study calculated the daily intake of macronutrients and micronutrients among college students in North India. The study found that all participants were taking less quantity of micronutrients as per Recommended Dietary Allowances (RDA) 2020. There was a significant difference in protein, fats and total energy (kilo calories) intake and Vit. B3, Vit. B6 and Vit. E intake among males and females.

The current study found a statistically significant difference in the total calories, and fat intake among females and males. A study by Yadhav H et al. reported significantly more calorie intake by males (1472 ± 417 Kcal) than females (1360 ± 380).[14] Another study found that the average calorie intake among adolescent girls was around 1693.33 kcal.[15] Despite the difference in the total calorie intake by males and females yet males on an average were consuming 19.3% less calories and females were consuming 12.4% less calories as recommended for their age groups i.e. 2110 kcal and 1660 kcal respectively.[16] The difference in the calories intake may be attributed to the daily needs of females and males.

The median (IQR) carbohydrates consumed by male and female participants were 279.5 (217.9-298.7) and 237.4 (221.3-299.9) g/day respectively. The RDA for carbohydrates is 130g/day for both sexes. Carbohydrate is the staple macro nutrient in northern Indian and is the main source of energy. The three major meals a day always contain carbohydrate as major portion. Although carbohydrate consumption in present study participants was more than the RDA, 2020 in both males as well as females but there was variability in carbohydrate consumption with genders also depicting that some participants were consuming more carbohydrates than other. Personal preferences, socio economic status of families, cultural preferences can affect the carbohydrate intake by people.

There was a significant difference in the fat intake by males 41.43 ± 12.4 and females 35.67 ± 12.1 in present study A study done in different metropolitan cities of India found that the average intake of fat among males was 34.1g/d while that in females was 31.1 g/d.[17] The RDA recommends that visible fat should be sedentary males should be 25 grams per day and for females should be 20 grams per day. People in northern part of India consume more visible fat than other parts of the country. More over the availability of processed food and fried food in the college canteens may contribute towards higher fat intake by college students.[18]

The median (IQR) proteins consumption in present study (males: 53.4 (49.2-58.9) females: 45.8 (40.1-49.8) gms/day) was almost equal to that of RDA (males: 54g/d and females: 46g/d) but there was wide

variation in protein intake by males and females among study participants. A study by Gupta *et al* in their study among adolescent girls found that the daily mean intake of protein, fat and energy intake was 53.3g/d, 47.8g/d and 1693 kcal/d respectively.[15]

A statistically significant difference was found between the average consumption of vit B3 (females: 5.04 ± 1.6; males: 5.45 ± 1.7), Vitamin B6 (males: 0.54 ± 0.23; females: 0.49 ± 0.21), Vitamin E (females: 0.62 (0.49-1.1); males 0.75 (0.53-1.3)) and Vit C (females: 49 (36.9-123.9) and males: 59.9 (37-127)) in current study. However, the intake was far less than that of RDA for males and females for these micronutrients. Besides that, other micronutrients such as Vit B1, Vit. B2, Vit. B4, Vit. B5, Vit. B9, Vit B12, Iron, magnesium, copper and calcium, although had non-significant difference in consumption among males and females in present study, but were very less than that was recommended by the RDA for each sex.[16] A study by Gupta et al also found that the majority of females micronutrient intake was less than of the RDA value.[15] A study by Awasthi *et al* among urban school-going children found that around 60% of the study participants had calcium deficiency while 49.4% had iron deficiency whereas folate, selenium and zinc were found deficits in 22.2%, 10.4% and 6.8% of the study participants.[19] In India half of the females in their reproductive age groups are anaemic, this low intake of calcium and iron especially among adolescent and young adult girls can lead to undesirable consequences in the near future for them and their children after marriage.

The current study found that almost half of the participants had normal BMI while 12.6% of the participants were underweight round 37% of the participants had BMI more than normal and around 38.1% of the study participants had high category risk based on Waist Hip Ratio. The Median BMI (IQR) was 21.8 (19.5-24.3) kg/m^2. A study by Rohilla *et al* found the prevalence of overweight to be 11% among adolescents in an urban city in north India.[20] Higher intake of fats, carbohydrates and physical inactivity as observed among our study participants leads to the deposition of fat around the waist region and thus leading to obesity and increasing the risk of non-communicable diseases such as diabetes mellitus, hypertension, cancer, stroke.[21]

The current study has some limitations. Firstly, it is cross-sectional study; the results can give a skewed interpretation of macro and micronutrient intake by the study participants. Secondly, the recall bias can influence the daily intake of nutrients. Thirdly, the nutrient intake was calculated using Dietcal software which may be prone to underestimation or overestimation of results as compared to if the values were derived from the blood samples. Social desirability bias while telling the type of food eaten can influence the outcomes. High variability in food intake may influence a mismatch in average macronutrient intake and average calories calculated.

CONCLUSION
The study concludes that there is more consumption of macronutrients such as carbohydrates and fats, while the micronutrients were consumed in quantity much below the RDA. The study recommends raising awareness among college students regarding importance of micronutrients for the normal functioning and development of the body. Importance to include physical activity in their daily routine can be encouraged to overcome the increased prevalence of overweight among college students and higher waist hip ratio.

REFERENCES
1. Higgs S. Social norms and their influence on eating behaviours. Appetite. 2015; 86:38–44.

Available from: http://dx.doi.org/10.1016/j.appet.2014.10.021

2. Godswill AC, Somtochukwu V, Ikechukwu AO. Nutritional diseases and nutrient toxicities: a systematic review of the diets and nutrition for prevention and treatment. Int J Adv Acad Res Sci. 2020; 6(1).

3. Ames BN. Low micronutrient intake may accelerate the degenerative diseases of aging through allocation of scarce micronutrient by triage. Proc Natl Acad Sci U S A. 2006; 103:17589–94. doi:10.1073/pnas.0608757103

4. Plotnikoff RC, Costigan SA, Williams RL, Hutchesson MJ, Kennedy SG, Robards SL, et al. Effectiveness of interventions targeting physical activity, nutrition and healthy weight for university and college students: A systematic review and meta-analysis. Int J Behav Nutr Phys Act. 2015; 12:1–10. doi:10.1186/s12966-015-0203-7

5. Shetty P. Nutrition transition and its health outcomes. Indian J Pediatr. 2013;80 Suppl 1:21–7. doi:10.1007/s12098-013-1088-7

6. Meenakshi J V. Trends and patterns in the triple burden of malnutrition in India. Agric Econ. 2016; 47:115–34. doi:10.1111/agec.12204

7. Gulati S, Misra A. Sugar intake, obesity, and diabetes in India. Nutrients. 2014; 6:5955–74. doi:10.3390/nu6125955

8. Rathi N, Riddell L, Worsley A. Food consumption patterns of adolescents aged 14-16 years in Kolkata, India. Nutr J. 2017; 16:1–12. doi:10.1186/s12937-017-0272-3

9. Eating a balanced diet - NHS. [cited 2023 Aug 28]. Available from: https://www.nhs.uk/live-well/eat-well/how-to-eat-a-balanced-diet/eating-a-balanced-diet/

10. World Health Organization. Micronutrients. [cited 2023 Aug 28]. Available from: https://www.who.int/health-topics/micronutrients#tab=tab_1

11. Bailey RL, West KP, Black RE. The epidemiology of global micronutrient deficiencies. Ann Nutr Metab. 2015; 66:22–33. doi:10.1159/000371618

12. Müller O, Krawinkel M. Malnutrition and health in developing countries. Can Med Assoc J. 2005; 173:279–86. doi:10.1503/cmaj.050342

13. Home | International Year of Millets 2023 | Food and Agriculture Organization of the United Nations. [cited 2023 Aug 28]. Available from: https://www.fao.org/millets-2023/en

14. Yadav H, Naidu S, Baliga SS, Mallapur MD. Dietary pattern of college going Adolescent (17-19 years) in Urban area of Belagavi. Int J Recent Sci Res. 2015; 6:3774–7.

15. Gupta A, Noronha JA, Shobha, Garg M. Dietary intake of macronutrients and micronutrients among adolescent girls: A cross-sectional study. Clin Epidemiol Glob Heal. 2018; 6:192–7. Available from: https://doi.org/10.1016/j.cegh.2018.02.010

16. ICMR-National Institute of Nutrition. Recommended Dietary Allowances & Estimated Average Requirements for Indians - 2020. 2020. 10 p.

17. ICMR-NIN. Assessment of visible fat consumption among urban population in 7 metro cities in India: National Nutrition Monitoring Bureau Urban Nutrition Surveys (2015-16). Fat Study Report: Part-2 [Internet]. 2019. Available from: https://www.nin.res.in/survey_reports/Fat_study_report_part-2.pdf

18. Kumari A, Kaur S. Consumption of canteen food items among college students of Ludhiana city. J Food Sci Nutr. 2017; 4:248–58.

19. Awasthi S, Kumar D, Mahdi AA, Agarwal GG, Pandey AK, Parveen H, et al. Prevalence of specific micronutrient deficiencies in urban school going children and adolescence of India: A multicenter cross-sectional study. PLoS One. 2022; 17:1–15. Available from: http://dx.doi.org/10.1371/journal.pone.0267003

20. Rohilla R, Rajput M, Rohilla J, Malik M, Garg D, Verma M. Prevalence and correlates of overweight/obesity among adolescents in an Urban City of North India. J Fam Med Prim Care. 2014; 3:404. doi:10.4103/2249-4863.148127

21. Anjana M, Sandeep S, Deepa R, Vimaleswaran KS, Farooq S, Mohan V. Visceral and central abdominal fat and anthropometry in relation to diabetes in Asian Indians. Diabetes Care. 2004; 27:2948–53. doi:10.2337/diacare.27.12.2948

******