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Fruits and vegetables consumption among young adults and its association with socioeconomic background, clinical signs and symptoms of micronutrient deficiencies

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Abstract
Fruit and vegetables are important components of a healthy diet. Scientific evidence suggests that their regular sufficient daily intake may exert a protective effect against micronutrient deficiencies and major chronic diseases such as cardiovascular diseases and certain cancers, the main risk factors for death and diseases. Due to the shift to a busy lifestyle and numerous curricular and extracurricular activities, young adults usually overlook healthy dietary behaviours. The present study aims to assess the fruit and vegetable consumption among young adults and to explore whether or not the socioeconomic factors determine the level of consumption, and also to analyse if the latter is associated with clinical symptoms of micronutrient deficiencies. The study was conducted among 393 young adult respondents of 18-25 years of age. An online survey was conducted using detailed questionnaire and information on demographic details, anthropometry, clinical data, and F&V consumption pattern. The collected data were analysed and interpreted, and the results show that the mean intake of fruits and vegetables among young adults is only 100-200g, which is much lesser than the requirement for adults. Only 6.79% of the respondents were found to consume >300g of fruits and only 11.3% consumed >300g of vegetables. It was found that an average of one clinical sign or symptom was present among the respondents. Statistical analysis revealed that there is a positive association between the amount of F&V consumed in a day and the family monthly income of the respondents ($p = 0.006$; $p = 0.027$). It was found that there exists a significant relationship between frequency of vegetable consumption and presence of clinical signs and symptoms ($p=0.030$) and between amount of fruit consumption per day and presence of clinical signs and symptoms ($p=0.041$). The present study highlights that F&V consumption among young adults (18-25 years) is lower than the recommendation for this age group and the F&V consumption pattern is associated with their family monthly income and presence of clinical signs and symptoms of nutritional deficiencies.

Keywords: clinical signs, fruits and vegetables, micronutrient deficiencies and symptoms

Introduction

Fruit and vegetables (F&V) are important components of a healthy diet. Scientific evidence suggests that their regular sufficient daily intake may exert a protective effect against micronutrient deficiencies and major chronic diseases such as cardiovascular diseases and certain cancers, the main risk factors for death and diseases (Augusto *et al*., 2014) [2].

In addition to the essential macronutrients (carbohydrates, fats, and proteins) that are needed for survival, vitamins, and minerals, known as micronutrients, contribute for the maintenance of good health and are necessary for proper growth and development. Dietary diversity helps individuals receive a nutritionally balanced intake of necessary vitamins and minerals, but many poor households around the world face food insecurity resulting in micronutrient deficiencies that lead to serious health consequences.

Micronutrient deficiencies are among one of the most pervasive forms of malnutrition, which affects about two billion people worldwide (WHO, WFP and UNICEF, 2007). Women and children are particularly vulnerable to micronutrient deficiencies and undernutrition due to higher growth and physiology requirements.

The effects of micronutrient deficiencies in the human body and the related public health burden are well documented. Two billion people are estimated to suffer from micronutrient deficiencies worldwide, with pregnant women and children under 5 years of age at the highest risk. The largest health burden of micronutrient deficiencies in LMIC is caused by deficiencies of vitamin A, iron, zinc, folate and iodine. Evidence from home garden interventions shows the impact of increased fruits and vegetables consumption on micronutrient intake. The potential of F&V to improve micronutrient status in LMIC however, needs further study. (Nijhuis and Brouwer, 2020) [5].

Clinical deficiencies may arise through inadequate diet, but they may also arise from impaired absorption, or an increased rate of turnover or of excretion. Clinical signs are notoriously non-specific. Although they may be the first warning sign that something is amiss, they are generally only the first step in a complex chain of evidence, which needs to include dietary investigations and biochemical index measurements, before a diagnosis can be made with confidence. Clinical signs in a population may represent only the 'tip of the iceberg' of morbidity and mortality that is attributable to a nutrient deficiency. (Bates, 1999) [3].

The present study was conducted with the objectives as to know the socioeconomic, anthropometric status, fruit and vegetable consumption pattern, the presence of clinical signs and symptoms of micronutrient deficiencies among the selected young adults. Also to assess the relationship between F&V consumption and Socioeconomic background of the respondents, F&V consumption and presence of clinical symptoms of micronutrient deficiencies. As well as to provide nutrition education on the importance and benefits of consuming fruits and vegetables.

Methodology

India is one of the largest producers and a net importer of many fruits and vegetables in the world. But the consumption is not very relevant. It is expected that the proportion of population will nearly double from 12 to 22%, between 2015 and 2050. This demographic shift comes with major health and socio-economic concerns. Nutrition is a fundamental determinant of both health and socio-economic concerns. Nutrition is a fundamental determinant of both health and disease and its role in extending a healthy lifespan is the object of considerable research. Notably, malnutrition is one of the main threats to health and quality of life among young adults. The study period was from December 2021 to May 2022. A questionnaire was created using google form and the link was circulated through various social media apps like WhatsApp, Facebook, and Instagram. The questionnaire included questions on sociodemographic, clinical and dietary assessment among the participants. The socio-demographic profile such as age, gender, and monthly income were assessed among the participants. Along with it, the participants were asked about their anthropometric profile which included their height and weight. The questionnaire also included pictorial questions on presence of clinical signs and symptoms of nutritional deficiencies, presence of known deficiencies, frequency, quantity and form of fruits and vegetables consumption among the participants. Young adults who received the google link filled out the questionnaire and submitted the google form in the same link.

Google forms store the responses received so we can analyse in detail. The forms are integrated with Google spreadsheets therefore we can access a spreadsheet view of the collected data. Hence it was comfortable to consolidate the collected data and analyse the results. The e-posters are posted to all the selected respondents through e-mail and WhatsApp. The feedback on nutritional education was noted. This was helpful for the respondents to know the changes in their dietary habits. The data collected was analysed and the correlation and chi-square tests were performed to assess the association between the fruits and vegetables intake among young adults with monthly income of family and presence of clinical signs and symptoms of micronutrient deficiencies among these respondents.

Results and discussion

1. Socio Economic profile

Around 72.77% (286) of the respondents are males and 27.22% (107) are females. Nearly 24.6% (97) of the respondents are in the age group of 18-20 among which 24.47% are females and 25.2% are males, 61.5% (242) of the respondents are in the age group of 21-23 among which 63.28% are females and 57% are males and 13.7% (54) of the respondents are in the age group of 23-25 among which 12.23% are females and 17.7% are males. It was found that 69.21% (272) of the respondents are full-time students among, 17.81% (70) of the respondents are employed, 6.61% (26) of the respondents are unemployed and 6.36% (25) of the respondents are in others category.

Among the respondents, the monthly family income of 27.48% (108) is below twenty thousand, 19.33% (76) of the respondent's family monthly income is between twenty thousand and thirty thousand, 23.91% (94) of the respondent's family monthly income is between thirty thousand and forty thousand and 29.26% (115) of the respondent's family monthly income is more than fifty thousand.

2. Anthropometric status

The mean height, weight and BMI of females are 158.25 ± 7.84, 54.96 ± 10.28 and 21.93 ± 3.68 respectively and the mean height, weight and BMI of males are 172.18± 9.38, 67.79 ± 13.23 and 22.9± 4.0 respectively.

Table 1: Anthropometric status of the respondents

Anthropometric Status		No. of subjects			
		Female (n=286)		Male (n=107)	
	Criteria*	Frequency	%	Frequency	%
Underweight	< 18.5	47	16.43	12	11.21
Normal	18.5-22.9	138	48.25	44	41.12
Overweight	> 23	77	26.92	38	35.51
Obese	23-24.9	24	8.39	13	12.14
Total		286	100	107	100

* Asian BMI Classification 2020

It was clear that 15.01% (59) of the respondent's BMI falls under 'underweight' category among which 16.43% are females and 11.21% are males, 46.31% (182) of the respondent's BMI falls under 'normal' category among which 48.2% are females and 41.12% are males, 29.26% (115) of the respondent's BMI falls under 'overweight' category among which 26.92% are females and 35.51% are males and 9.41% (37) of the respondent's BMI falls under 'obese' category among which 8.39% were females and 12.14% are males.

3. Presence of clinical signs and symptoms in the selected subjects

The below table shows the presence of clinical signs and symptoms recorded by the study participant subjects

Table 2: Presence of clinical signs and symptoms in the selected subjects

S. No	Clinical Signs and Symptoms	No of responses (n=339) Mean ± SD	
		Female	Male
1	Dry scaly skin (xerosis)	8 ± 1.4	6 ± 1.3
2	Skin rash	29 ± 4.1	4 ± 1.1
3	Dull dry brittle hair	30 ± 5.3	6 ± 1.4
4	Corkscrew hair	8 ± 1.6	2 ± 0.3
5	Pale eyes (Pallor)	42 ± 7.6	11 ± 2.3
6	Conjunctival Inflammation	3 ± 0.9	2 ± 0.7
7	Night Blindness	0	0
8	Redness of mouth or lips	5 ± 1.2	8 ± 1.6
9	Angular fissures	8 ± 1.5	4 ± 0.4
10	Swollen, smooth tongue	2 ± 0.4	2 ± 0.4
11	Bleeding gums	22 ± 3.8	6 ± 1.5
12	Mouth ulcers	57 ± 7.5	35 ± 5.2
13	Brittle Nails	20 ± 3.2	3 ± 0.2
14	Spoon Shaped Nails	0	0
15	Scaling of skin around nostrils (nasolabial seborrhea)	40 ± 6.5	12 ± 2.2
16	Ataxia	0	0
17	Easy bruising, excessive bleeding from wounds and oozing from nose	0	0
18	Loss of tooth enamel	11 ± 1.9	5 ± 2.1
19	Bone tenderness	2 ± 0.8	2 ± 0.3
20	Bone/joint pain	11 ± 1.7	3 ± 0.5
21	Muscle wasting and weakness	6 ± 1.2	2 ± 0.4
22	None	115 ± 12.5	43 ± 8.2

From the above table it was evident that the majority of the respondents (115 ± 12.5 females and 43 ± 8.2 males) reported that they had no clinical symptoms. Among the female participants, mouth ulcers (57 ± 7.5), pale eyes (42 ± 7.6), and nasolabial seborrhea (40 ± 6.5) were the most recorded symptoms. In male participants also it was obvious that mouth ulcers (35 ± 5.2), nasolabial seborrhea (12 ± 2.2) and pale eyes (11 ± 2.3) were the most recorded symptoms. It was pleasant that the symptoms like night blindness, spoon shaped nails and easy bruising, excessive bleeding from wounds and oozing from nose were not prevalent whereas the other symptoms had minimal occurrence.

4. Fruits and vegetables consumption pattern

It was noticeable that 30.2% (119), 8.1% (32), 3.56% (14), 27.4% (108), 25.4% (100) and 5.0% (20) of the respondents consume fruits once a day, twice a day, more than twice a day, once in a week, 2-4 days a week and 5-6 days a week respectively. The responses of the study were analysed to find that 31.5% (124), 48.3% (190), 13.2% (52), 4.5% (18), 2.29% (9) of the respondents consume less than 100 grams, 100-200, 200- 300 300-400 and more than 400 grams of fruits in a day, respectively. It was understood that 81.9% (332) of the respondents consume fruits in raw form, 17% (68 subjects) of the respondents consume fruits as juices/ 71 smoothies, none of the respondents consumed fruits as sweets/desserts and only one percent (3) of the respondents consumed fruits in cooked form.

The results of the study show that 49.8% (196), 24.4% (96), 11.4% (45), 5.3% (21), 5.8% (23), 3.0% (12) of the respondents consume vegetables once a day, twice a day, more than twice a day, once in a week, 2-4 days a week and 5-6 days a week respectively.

Nearly 22.3% (88), 45.5% (179), 20.6% (81), 9.6% (38), and 1.7% (7) of the respondents consume less than 100 grams, 100-200 grams, 200-300 grams, consume 300-400 grams and more than 400g of vegetables per day. It was understood that 4.07% (16) of the respondents consume vegetables in raw form, 94.9% (373) of the respondents consume vegetables in cooked form, 0.5% (2) of the respondents consume vegetables as juices/smoothies and 0.5% (2) of the respondents consume fruits in pureed form.

The study revealed that 87.5% (344) prefer consuming snacks and 12.46% (49) do not prefer consuming snacks. It has been found that 52.4% (206) of the respondents consume packed food, 14.7% (58) of the respondents consume fried foods, 12.2% (48) of the respondents consume fruits and vegetables, 8.1% (32) consume nuts as snacks and 12.4% (49) do not prefer consuming snacks.

Nearly 16.53% (65) of the respondents purchase fruits and vegetables daily, 77.35% (304) of the respondents purchase fruits and vegetables weekly twice or thrice and 6.10% (24) of the respondents consume fruits and vegetables monthly. Around 74.55% (293) of the respondents have tried to increase their fruits and vegetables intake in the past one year and 25.44% (100) of the respondents have not tried to increase their fruits and vegetables intake in the past one year.

It has been found that 81.17% (319) of the respondents have planned to increase their fruits and vegetables intake in the next 6 months and 18.82% (74) of the respondents have planned to increase their fruits and vegetables intake in the next 6 months. The respondents self-reported their opinion on the overall fruits and vegetables intake in the diet, and it has been found that 5.34% (21) of the respondents had very high intake, 19.59% (77) of the respondents had high intake, 63.35% (249) of the respondents had moderate intake, 9.66% (38) of the respondents had low intake and 2.03% (8) of the respondents had very low intake.

Evidence shows that unhealthy dietary behaviour puts college students and young adults at risk for chronic diseases. A study conducted by (Kicklighter *et al*., 2010) [4] reports that 60.8% of college students consume one or two servings of fruits and vegetables per day. Among the students from Kuwait University (KU), 26.6% of males and 24.7% of females reported consuming >2 servings a day of whole F/V, respectively, as assessed by a semiquantitative food frequency questionnaire (Alkazemi, 2019) [1]

5. Relationship between FV Consumption Pattern and Socio-economic background

The association between fruits and vegetable consumption and socio-economic background was analysed and discussed in the below table.

Table 3: Relationship between monthly income of family and fruits and vegetable consumption

Correlations		
		Monthly income of Family
How often do you consume vegetables?	Pearson Correlation	-0.74
	Sig. (2-tailed)	0.143
	N	393
How many grams of vegetables do you eat in a day	Pearson Correlation	0.111*
	Sig. (2-tailed)	p value = 0.027
	N	393
*. Correlation is significant at the 0.05 level (2-tailed)		
How often do you consume fruits?	Pearson Correlation	-0.074
	Sig. (2-tailed)	0.144
	N	393
How many grams of fruits do you eat in a day	Pearson Correlation	0.137**
	Sig. (2-tailed)	p value = 0.006
	N	393
**. Correlation is significant at the 0.01 level (2-tailed)		
How often do you purchase fruits and vegetables?	Pearson Correlation	-0.053
	Sig. (2-tailed)	0.291
	N	393

The H0 is that there is no relationship between family monthly income and fruits and vegetables consumption pattern and H1 is that there is a relationship between family Monthly income and Fruits and vegetables consumption pattern. From the above table it is evident that the Sig. value is 0.143, which is greater than the level of significance 0.05. Thus, we accept the null hypothesis. Therefore, there is no significant relationship between the family monthly income and frequency of vegetable consumption.

Amount of vegetables consumed per day

The Sig. value is 0.027, which is lesser than the level of significance 0.01. Thus, we reject the null hypothesis and accept the alternate hypothesis. Therefore, there is a positive, and significant relationship between the family monthly income and amount of vegetable consumption per day.

Frequency of fruits consumption
The Sig. value is 0.144, which is greater than the level of significance 0.05. Thus, we accept the null hypothesis. Therefore, there is no significant relationship between the family monthly income and frequency of fruit consumption.

Amount of fruits consumed per day
The Sig. value is 0.006, which is lesser than the level of significance 0.01. Thus, we reject the null hypothesis and accept the alternate hypothesis that there is strong, positive, and significant relationship between the family monthly income and amount of fruits consumption per day.

Frequency of F and V purchase
The Sig. value is 0.291, which is greater than the level of significance 0.05. Thus, we accept the null hypothesis. Therefore, there is no significant relationship between the family monthly income and frequency of fruit and vegetable purchase

6. Relationship between F&V consumption pattern and Clinical Signs and Symptoms
Fruit and vegetable intake may exert a protective effect against micronutrient deficiencies. The association between fruits and vegetable consumption pattern and clinical signs and symptoms were analysed and discussed in the below table.

Table 4: Relationship between F&V consumption pattern and Clinical Signs and Symptoms

Correlations		
		Presence of clinical signs and symptoms
How often do you consume vegetables?	Pearson Correlation	0.109*
	Sig. (2-tailed)	p value = 0.030
	N	393
*. Correlation is significant at the 0.05 level (2-tailed).		
How many grams of vegetables do you eat in a day	Pearson Correlation	0.017
	Sig. (2-tailed)	0.740
	N	393
How often do you consume fruits?	Pearson Correlation	-0.029
	Sig. (2-tailed)	0.572
	N	393
How many grams of fruits do you eat in a day	Pearson Correlation	0.103*
	Sig. (2-tailed)	p value = 0.041
	N	393
**. Correlation is significant at the 0.05 level (2-tailed)		

The H0 is that there is no relationship between presence of clinical signs and symptoms and fruits and vegetables consumption pattern. H1 is that there is a relationship between the presence of clinical signs and symptoms and fruits and vegetables consumption pattern.

Frequency of vegetable consumption
The Sig. value is 0.030, which is lesser than the level of significance 0.05. Thus, we reject the null hypothesis. Therefore, there is a significant relationship between presence of clinical signs and symptoms and frequency of vegetable consumption

Amount of vegetables consumed per day
The Sig. value is 0.740, which is greater than the level of significance 0.05. Thus, we accept the null hypothesis. Therefore, there is no significant relationship between the presence of clinical signs and symptoms and amount of vegetable consumption per day

Frequency of fruits consumption
The Sig. value is 0.572, which is greater than the level of significance 0.05. Thus, we accept the null hypothesis. Therefore, there is no significant relationship between the presence of clinical signs and symptoms and frequency of fruit consumption

Amount of fruits consumed per day
The Sig. value is 0.041, which is lesser than the level of significance 0.05. Thus, we reject the null hypothesis. Therefore, there is a significant relationship between presence of clinical signs and symptoms and amount of fruits consumed per day

Conclusion
The study revealed that there is an association between the amount of vegetables consumed in a day and the BMI category of the respondents. Furthermore, it has been found that there exists a significant relationship between family monthly income and F&V consumption pattern, especially the amount of fruits and vegetables consumed in a day. Respondents who belong to the higher income group (>50000 per month) consume more amounts of F&V. Significant correlation between frequency of vegetable consumption, amount of fruits consumed and presence of clinical signs and symptoms has also been observed in this current study. CDC recommends consuming 1.5-2 cups of fruits per day (300-400g) and 2-3 cups of vegetables per day (400-600g), but the current study reveals that the average fruits and vegetable consumption in the young adult population is only 100-200g. To improve awareness on F&V intake and its importance in improving holistic health by preventing Non Communicable Diseases, and micronutrient deficiencies, campaigns in colleges and the workplace can be conducted. The young adult population must be reminded and encouraged to include 4-5 servings each of fruits and vegetables in their daily diet. Mobile apps to track and record F&V consumption can be made available in order to encourage increased intake of F&V instead of packaged and junk foods.

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