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Assessment of Macro Nutrients and Micro Nutrients Intake of Collage Age Population: A Population Based Study

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Abstract

Background: In present India, due to increased urbanization and various other factors, there is a drastic change in the dietary patterns of college students and young adults. Maintaining the right eating habits of college students means a lot for the prevention of many diseases that could occur in an adult period. **Aim:** To evaluate the Macro and micro nutrients intake of the college population of Chennai **Methods and Tools:** Using Random sampling techniques, 1000 (500 male and 500 female) college students were selected, and data regarding food frequency intake were evaluated. Nutrient intake is assessed using a three-day dietary record. The subjects recorded the food consumed for three consecutive days. Food intake data were converted into raw amounts in terms of food groups and, in turn, were translated into energy, protein, fat, carbohydrate, and fiber using food composition tables. The nutrient intakes of the subjects were computed against Recommended Dietary Allowance (RDA) for ensuring the appropriateness of intake derived based on RDA. The data were tabulated and subjected to appropriate statistical analysis. **Results:** Consumption of Macro nutrient intake and micro nutrients were found to be more among males than females. Only vitamin C intake found to be more among females than males. It is clear that both male and female did not meet the requirements of RDA. Fat intake was more than the RDA for both male and female participants. **Conclusion:** Our study concludes that Macro and micro nutrient deficiency is prevalent among our study population, irrespective of the gender, whereas fat intake is more than the RDA, which is the leading cause for obesity and other non-communicable diseases. Thus it is essential to educate the students to consume nutrient-dense food and reduce the intake of dense energy food.

Keywords: Recommended Dietary Allowance, Macro Nutrients, Micro Nutrients, Deficiency, Noncommunicable Disease, Balanced Diet

Introduction

A balanced diet is conventionally defined as the one containing a variety of foods in appropriate proportions that are required for energy, amino acids, vitamins, minerals, fats, carbohydrates and other nutrients needed for maintaining health, vitality and general well-being and also stores a small amount of nutrients to be used during the duration of leanness (Goswami, 2017).

The nutrients are mainly grouped into six classes that include carbohydrates, fats, proteins, vitamins minerals, and water. The nutrients, carbohydrates, proteins, and fats supply energy (Muzafar Ahmad, 2018). Nutrition can be termed as the supply or provision of necessary materials that support life in cells and organisms. The recent nutrition transition in developing countries from traditional fiber-rich diets to "western-styled" fast-foods has to be found to affect the dietary habits of young adults, such as students of universities and other tertiary institutions (Patricia Ogechi Ukegbu, 2017).

Unhealthy eating habits are of major concern in the case of public health among college-going students who go through a significant change in lifestyle during university life where they are exposed to stress and lack of time (**Kurubaran et al., 2013**). More college students and adolescents are adopting western dietary styles, along with snacking behavior (**Prasanna Mithra, 2018**). Ages between 19-22 are a phase of emerging adulthood for an individual. It is a unique period where they are enrolled in college and the phase of transition from school to college, where they face emotional and social pressures.

Objectives

To study the macro and micro nutrients intake of the study population

Review of Literature

The main problem in the world is the foodstuff deficiency, including micronutrients. Estimates showed that more than 2 billion people around the world are affected by the lack of essential vitamins and minerals, particularly vitamin A, iodine, and zinc. Nutrient deficiency is a risk factor leading to the global burden of diseases (**Al-Rethaiaa, 2010**). A diet deficient in nutrients can cause health issues ranging from tiredness, lack of energy to serious issues involving loss of function of vital organs, lack of growth, and development (**Swetaa, 2018**). Micronutrient deficiency largely goes unnoticed by the general public, by many decision-makers and even by the affected individuals themselves (**Patil, 2009**). This is why this form of malnutrition is also called 'hidden hunger' (**Stein, 2006**). Micronutrient deficiency is mainly caused by the lack of a balanced diet. While often providing enough calories, monotonous diets based on cereals and other starchy staple foods, frequently fail to deliver sufficient quantities of essential minerals and vitamins (**Jyoti Tak, 2016**). A report published in British Nutrition Foundation (BNF) has re-confirmed that a huge proportion of adolescents have been found to have a low intake of vitamins and minerals, in particular, Vitamin A, riboflavin, iron, calcium and magnesium (**Mrigen, 2015**).

Anemia remains to be one of the most widespread nutritional disorder worldwide. Anemia (from the ancient Greek, anemia, meaning 'lack of blood')

is defined by a "decrease in the total amount of hemoglobin or the number of red blood cells." Iron deficient anemia is a form of anemia that occurs due to a deficiency of iron to synthesize red blood cells. This is typically caused due to inadequate intake of iron, or chronic blood loss, or a combination of both these circumstances (**Terri, 2011**). It is a ubiquitous cause of anemia in the world (**Vidya 2014**). Nutritional deficiency anemia can lead to the development of headache, fatigue, lethargy, apathy, exertional dyspnoea, palpitations, and tinnitus and thereby decrease the nature of everyday life to a great extent. Such symptoms may pose a hindrance to students in their academic life and hurt their careers (**Ningappa Asha Rani, 2017**).

A study by **Bhardwaj (2013)** conducted in the state of Himachal Pradesh, India, reported that vitamin B12 deficiency to be prevalent in all enrolled adolescents in their study. Vitamin B2 or Riboflavin is a metabolically a very important vitamin; though there is marked dietary, biochemical and clinical evidence of riboflavin deficiency, it has not received adequate attention because its deficiency is neither a killer nor a cripple. There is evidence of dietary and biochemical folic acid deficiency in India. It can cause megaloblastic anemia due to impaired red cell maturation. Folic acid deficiency has also been implicated in congenital (neural tube) malformation. Supplementation with folic acids in early pregnancy or even pre-pregnant state has been reported to prevent it. Folic acid deficiency leads to raised levels of serum homocysteine levels. Serum homocysteine is an independent risk-factor in the case of cardiovascular disease. Evidence suggests that Indians do tend to have high amounts of homocysteine, which responds to treatment with folic acid (**Alok Moitra, 2011**).

Vitamin B complex deficiency signs were seen in 20.6% of students. Vitamin C deficiency signs were seen in 9.9% of students. The essential fatty acid deficiency was observed in 14.1% of students. Another study conducted by **Rema (2011)** reported the prevalence of vitamin A deficiency among boys to be 5.65% and in girls to be 8.64%. According to **Deb (2010)**, a total of 40.8 % of boys and 25.93% of girls were underweight. About 76% of boys and 74% of girls were suffering from one or more morbidities.

Methodology

About 1000 samples (500 males and 500 females) in the age group of 19 to 22 years were selected using a purposive random sampling method. The study samples were college students who belonged to the Arts and Science colleges of North Chennai. Subjects who were not on any kind of medical complication were selected for the study. Physically challenged, pregnant, and lactating women were excluded from the study. Before the commencement of the study, Ethical clearance was obtained from the Universal Ethics Committee (UEC). After selecting the colleges for research purposes, permission was obtained from the respective college authorities for conducting the study. Since all our study participants were majors (aged 18 years and), written consent to participate in the study was got from all of them. The selected participants who have consented to be a part of the study were informed about the study and its importance by the researcher so that they would cooperate and make possible in collecting the necessary information for the study

Nutrient intake is assessed using a three-day dietary record. Measuring cups were exhibited to the participants by the researcher. This helps the participants to mention the exact amount of the food consumed by them, and participants were recorded each food they consumed (with the amount) in 24 hours and returned the schedule to the researcher. The three-day dietary record method was used to record the daily eating pattern, which includes the type and the amount of food chosen for each meal. The food consumed for three consecutive days were recorded by the subjects. Food intake data were converted into raw amounts in terms of food groups, and turn was translated into energy, protein, fat, carbohydrate, and fiber using food composition tables (**Gopalan, 2002**). The nutrient intakes of the subjects were computed against Recommended Dietary Allowance (RDA) for ensuring the appropriateness of intake derived based on RDA. The data were tabulated and subjected to appropriate statistical analysis.

Results and Discussion

Mean Macro Nutrient Intake

Nutrients	Male (N=500)		Female (N=500)		t value	P value
	Mean	SD	Mean	SD		
Energy (kcal)	1763.98	169.08	1408.30	222.7	28.443	<0.001**
Protein (gram)	36.43	5.16	32.35	5.17	12.446	<0.001**
Fat (gram)	45.54	4.95	39.23	6.80	16.770	<0.001**
Carbohydrates (gram)	301.78	33.04	231.78	46.40	27.476	<0.001**
Fiber (gram)	13.87	1.69	10.58	2.86	22.036	<0.001**

The basic energy requirement of an individual is the level of energy intake through food that will help in balancing the energy expenditure of the individual who has a body size and composition, and level of physical activity, consistent with long-term good health, and that will allow the maintenance of economically necessary and socially desirable physical activity (**Kathleen Mahan, 2000**). Mean energy intakes of male and female participants were found to be 1763±169 kcal and 1408 ±222 kcal per day, respectively, whereas the RDA for males and females was found to be 2320 kcal and 1900 kcal, respectively. It showed that 75% and 74% of the daily energy requirement is met by male and

female participants, respectively. The energy intake of both the groups of participants was less than the recommended allowances, which shows the deficit in their energy intake. A similar study by **Abdull Hakim (2012)** indicated a deficiency of energy intake in the majority of students. The inadequacy of energy intake derived from low energy intake in the diet may lead to poor intake of the other essential nutrients from the diet.

Dietary protein is needed for growth, maintenance, and repairs of body tissue, and it also regulates the key processes within the body, and any excess protein can be used as a source of energy. When the protein intake was assessed, it was evident

that males consumed 36 ± 5.1 grams of protein, and females consumed 32 ± 5.1 grams per day. The RDA for Indians is 60 grams and 55 grams for males and females, respectively, which is far beyond intake by our study participants. Only 60% and 58% of the daily protein requirement is met by male and female participants, respectively.

Fats are generally trimesters of glycerol and fatty acids. Fats or lipids taken inside the body are broken down by enzymes called lipases, which are produced in the pancreas. Excess fats are generally considered as harmful to the human system and are generally restricted or avoided. When fat intake was assessed among the participants, about 45 ± 4.9 grams and 39 ± 6.8 grams per day of fat were consumed by male and female participants, respectively, which is much higher than the RDA (25 grams and 20 grams and male and female respectively). Most of our study participants consumed fried foods, namely bonda, bajji, samosa, and chips, which are the sources of dietary fat. Higher fat intake leads to an increase in the risk of overweight and obesity among college students.

Carbohydrates are the main energy source of the human body. The primary use of carbohydrates is to serve as energy suppliers to the body, especially to

the brain and the nervous system. An enzyme called amylase helps to break down carbohydrates into glucose (blood sugar), which can be then used for energy synthesis by the body. The mean carbohydrate intake among male and female participants was found to be 301 ± 33 grams and 231 ± 46 grams per day, respectively.

Dietary fiber is defined as “**the portion of food derived from the plant cells, which is resistant to hydrolysis/ digestion by the elementary enzymes system in the human being.**” It consists of hemicellulose, cellulose, lignin, oligosaccharides, pectin, gums, and waxes. When the fiber intake of the participants was compared favorably, it showed inadequate intakes for both females and males. The RDA for fiber intake is 30 grams per day, whereas males consume 13 ± 1.6 grams and females consume only 10 ± 2.8 grams per day.

The macronutrients (protein, carbohydrates, and fat) intake in the present study are found to be high among male students when compared to female students. The mean energy and macro nutrients for both the genders are much lower than the RDA, thereby indication the failure of the participants to meet the RDA.

Mean Minerals Intake

Nutrients	Male (N=500)		Female (N=500)		t value	P value
	Mean	SD	Mean	SD		
Iron (mg)	11.31	2.55	9.54	2.76	10.509	<0.001**
Zinc (mg)	6.57	1.46	5.61	1.22	11.126	<0.001**
Calcium (mg)	426.23	46.12	390.71	77.51	8.805	<0.001**

The importance of calcium for young adults is immeasurable as it is the main structural element of bones and teeth and helps in the growth, maintenance, and reproduction of the human body. In spite of the benefits of calcium, the intake is found to be very low. RDA for calcium is 600 mg for both the genders, whereas our study participants consumed only 426 ± 46 grams and 390 ± 77 grams per day by males and females, respectively. From the dietary pattern, it is evident that milk and milk products consumption is found to be less frequent, which leads to low calcium levels. This showed only 71% and 65% of RDA for calcium is met by males and females, respectively.

Iron is an essential mineral that plays a key role in the making of healthy red blood corpuscles. Unfortunately, the majority of the participants had intakes below the RDA for iron. Analysis of iron intakes indicated that mean iron consumption of 11 ± 2.5 milligrams by male and 9.5 ± 2.7 milligrams by female, which showed that only 64% and 40% of the iron requirement is met by the male and female participants respectively. The RDA for iron is 17 milligrams and 21 milligrams for males and females, respectively. The low iron intake results in a higher prevalence of iron deficiency anemia in the current study.

Zinc deficiency was first identified in the male subject of Iranian origin and is since identified as a major problem of malnutrition worldwide. It is highly prevalent in regions that consume high amounts of cereals and comparatively lower quantities of animal foods. The diet may not directly be deficient in zinc, but its bioavailability is a matter of concern

as it causes low uptake levels. Phytic acid is found to be a major inhibitor of zinc (**Nazanin Roohani, 2013**). Zinc intakes were below 50% of the RDA level. The average zinc intake in the present study is 6 ± 1.4 milligrams in males and 5 ± 1.2 milligrams in females, whereas the RDA is 12 milligrams and 10 milligrams, respectively.

Mean Water Soluble Vitamins of the Subjects

Nutrients	Male (N=500)		Female (N=500)		t value	P value
	Mean	SD	Mean	SD		
Vitamin B1 (mg)	.748	.127	.583	.132	20.112	<0.001**
Vitamin B2 (mg)	.886	.124	.740	.128	18.246	<0.001**
Vitamin B3 (mg)	10.34	2.17	8.11	1.63	18.246	<0.001**
Vitamin B6 (mg)	12.916	1.76	12.93	1.52	.157	0.875
Vitamin B12 (mcg)	.61	.09	.61	.11	.009	0.993
Folic acid (mcg)	127.02	19.45	118.9	19	6.604	<0.001**
Vitamin C (mg)	22.54	3.35	24.88	3.84	10.239	<0.001**

In the present study, water, soluble vitamins such as B complex, and vitamin C intake were evaluated. B vitamins are a class of water-soluble vitamins that play important roles in cellular metabolism. B complex vitamins help the body to make energy from the food we eat and form red blood cells. Mean vitamin B1 intake was 0.748 milligrams and 0.583 milligrams among male and female participants, whereas the RDA is 1.2 milligrams and 1.0 milligrams, respectively. When mean Vitamin B2 was analyzed, males consumed .886 milli gram and females consumed .740 milligram per day. The RDA for Vitamin B2 is 1.4 milligrams and 1.1 milligrams, respectively. Mean Niacin was reported to be 10.3 ± 2.1 milligram and 8.11 ± 1.6 milligram per day by male and female participants, respectively. The RDA for niacin is 16 milligrams and 12 milligrams for males and females, respectively. Vitamin B6 consumption was found to be similar in both genders. The mean average of vitamin B6 was found to be 12.9 milligrams per day, whereas the RDA is 20 milligrams per day. A study conducted by **Malara et al. (2013)** showed an inadequate intake of vitamins B1, B2, and B6.

Vitamin B12 has a key role in the normal functioning of the nervous system through biosynthesis of myelin (myelinogenesis) and in the maturation of developing Red Blood cells in the

bone marrow. It also plays an important role in the metabolism of every cell of the human body; it is a cofactor in DNA synthesis, fatty acid, and amino acid (Suartha Pruekaritanond, 2013). The mean vitamin B12 intake of both the genders was found to be 0.61 micrograms per day, whereas the RDA for vitamin B12 is one microgram for both the genders. This shows that only 60% of the recommended allowance is met by the study participants.

Folic acid is required for the proper development of the human body in itself. It is majorly involved in the synthesis if genetic material called the DNA and also in numerous other bodily functions. Folic acid consumption is important in a woman of childbearing age to prevent neural tube diseases. But in our current study, Folic acid intake was significantly lower than RDA. The mean folic acid intake of males was 127 ± 19.4 micrograms, and females were 118 ± 19 micrograms per day. But about 200 micrograms of folic acid is recommended. This showed that only 63% and 59% of RDA is met by male and female participants, respectively.

Vitamin C is an antioxidant that plays a protective role in the body and is required to build and maintain healthy skin, bones, and teeth and to heal wounds. It was observed that Vitamin C consumption was less than the recommended levels. The mean vitamin C intake was found to be 22 ± 3.3 milligrams in

males and 24 ± 3.8 milligrams in females, whereas the recommended value is 40 milligrams per day. Ascorbates and citrates increase the absorption of iron into the body by acting as a weak chelator to solubilize the duodenum (Nazanin Abbaspour et al., 2014).

Conclusion

Younger populations constitute future pillars which would help to promote the growth and development of our country. Thus, it is essential to maintain the health of college students in terms of nutrition. Healthy cooking practices help to prevent micronutrient deficiency. Initiation of the kitchen garden at home and the inclusion of iron and other micronutrients-rich foods should be encouraged.

Increased weight and BMI (overweight) are associated with the risk of non-communicable diseases such as diabetes, hypertension and heart diseases, and few types of cancer. On the other hand, underweight status, as influenced by poor nutritional intake, also poses more risk for the onset of communicable disease.

Effective policies and programs are urgently required to reduce both forms of malnutrition. Nutrition professionals should take up the role, and spread the awareness in the general public and give them better guidance. A well-balanced diet, periodic physical activity, sufficient sleep, with good life style habits help in sound mind and healthy body leading to a happy life.

Limitation of the Study

1. Fat-soluble vitamins intake was not assessed
2. Only Chennai students were chosen for the study
3. Students in the other age group were not chosen for the study

Recommendation for Future Research

1. Present research should be carried out in children and adults
2. Apart from Chennai, other metropolitan areas should be covered
3. This kind of research should be carried out among rural students.

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