

# “Signs are Brisk when Nutrients at risk, act fast before last!!”: A study on Impact of Nutritional Intake on Clinical Manifestation

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## ABSTRACT

The present study explored the impact of nutritional intake on clinical manifestation. Physical signs and symptoms of malnutrition can be valuable aids in detecting nutritional deficiencies. Protein and micro nutrient deficiency have been the major nutritional problems faced by developing countries such as India. This study was conducted among 1000 students. The samples are selected by means of stratified sampling and simple random sampling techniques. Adopting Anthropometry (Waist circumference, Hip circumference, Waist to Hip ratio), Biochemical (Hemoglobin using Drabki method, Clinical, and Dietary details (Food frequency, three day dietary record) were obtained from the subjects by appropriate methods. The obtained details were coded and entered into Microsoft excel. The coded raw data were subjected to statistical analysis using Statistical Package for Social Science (SPSS) version 20.0. Anthropometry, biochemical, clinical, dietary details were correlated and results were interpreted. The effect of low hemoglobin on clinical manifestation was observed in the present study. It demonstrated that low hemoglobin levels resulted in a number of manifestations such as hairloss, recurrent mouth ulcer, angular stomatitis, glossitis, depression, irritability, poor concentration. Overweight and obese subjects manifested with acanthosis nigricans, whereas underweight subjects reported to have loss of appetite, loss of taste, poor concentration, irritability and recurrent mouth ulcer. Subjects with increased waist circumference, hip circumference, and waist to hip ratio were presented with the symptoms of acanthosis nigricans and goiter. Thus it is essential for the college students to

consume nutrient rich foods and avoid energy dense food to maintain adequate nutritional status and prevent deficiencies.

**Keywords:** *Manifestation, Nutritional status, Hemoglobin, Overweight, Waist circumference, Under nutrition*

## INTRODUCTION

Nutritional status plays a vital role in deciding the health status of a community. Nutritional deficiencies give rise to various morbidities which in turn, may lead to increased disability and even mortality. It is now well established that anthropometric device is a prerequisite in nutritional evaluation and for determining nutritional status of a particular community, like being overweight, undernourished, obesity, muscular mass loss accompanied with fat mass gain, adipose tissue redistribution, skeletal health. Its indicators are employed to evaluate the health status of a community and even for prognosis of chronic as well as acute diseases for medical intervention in people of all ages. *Sutapa Patta* in his article mentioned that ‘earlier, several investigators all over the world had used similar anthropometric characteristics and nutritional status of the adults from varying ethnic groups<sup>1</sup>.

As mentioned by WHO, underweight and obesity are the common health conditions in developed and in developing countries. Inadequate intake, excessive losses, malabsorption, increased requirement, body image and self-esteem

level leads to underweight. Many factors facilitates progression to obesity like sedentary lifestyle, increased junk food consumption, decreased physical activity, high use of smart gadgets, improper diet habits, social history such as smoking and alcohol and improper sleep patterns<sup>2</sup>. Global diets have become rich in calories but can be poor in some essential nutrients. More and more people are becoming overweight and obese while failing to meet dietary nutrient requirements. As a result, overweight and nutrient deficiencies exist. The latter sometimes known as 'hidden hunger'. Both over-nutrition and under-nutrition are viewed as different forms of malnutrition<sup>3</sup>.

The nutrients are mainly grouped into six classes that include carbohydrates, fats, proteins, vitamins minerals and water<sup>4</sup>. The nutrients, carbohydrates, proteins and fats supplies energy. 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 be found to affect the dietary habits of young adults, such as students of universities and other tertiary institutions<sup>5</sup>. Drastic and speedy changes in diets and lifestyles have occurred with growing industries, urban life, global marketing of goods and increase in economic development with people with easy access to fast foods, luxurious and cost lifestyles. This trend is becoming more harmful for developing countries such as India<sup>6</sup>.

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 global burden of diseases<sup>7</sup>. 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<sup>8</sup>. Micronutrient deficiency largely goes unnoticed by the general public, by many decision makers and even by the affected individuals themselves<sup>9</sup>. This is why this form of malnutrition is also called 'hidden hunger'<sup>10</sup>. Micronutrient deficiency is mainly caused by lack of balanced diet. While often providing enough calories, monotonous diets based on cereals and other starchy staple foods frequently fail to deliver the sufficient quantities of essential minerals and vitamins<sup>11</sup>. A report published in British Nutrition Foundation (BNF) has re-confirmed that a huge proportion of adolescents have been found to have low intake of vitamins and minerals, in particular, Vitamin A, riboflavin, iron, calcium and magnesium<sup>12</sup>.

## MATERIALS AND METHODS

**Research Design:** The research design for the present study is of experimental type.

**Sampling Design:** In the present research, the samples are selected by means of stratified sampling and simple random sampling techniques.

**Study Area:** This study was conducted at three Arts and Science Colleges situated in North Chennai (two Government colleges and one government aided college).

**Sample Size:** This study was conducted among 1000 students. Among them, 500 participants were male and 500 participants were female.

### (i) Inclusion Criteria

- **Consent:** Willingness of the participants to participate in the undertaken study was confirmed.
- **Age:** Participants aged between 19- 22 years were selected.
- **Gender:** Both male and female participants agreed on.
- **Permission:** Permission was obtained from the concerned authorities of the institution
- **Stream:** Government and Government aided Arts and Science College students were selected

**(ii) Exclusion Criteria:**

- Participants with any other disease complication were excluded.
- Pregnant and lactating women were excluded
- Participants taking steroids or immune suppressants were excluded from the study.
- Physically challenged students were excluded.

**Steps in conducting the study:**

**(a) Ethical clearance**

Ethical clearance was obtained from Universal Ethics Committee (UEC) before commencement of the study.

**(b) Permission from college authorities:**

After selecting the colleges for research purpose, permission was obtained from the respective college authorities for conducting the study.

**(c) Selection of Participants:**

As per the above-mentioned methodology along with inclusion and exclusion criteria, 1000 students were randomly selected from North Chennai colleges.

**(d) Consent and Orientation:**

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.

**(e) Collection of Data**

Adopting Anthropometry (Waist circumference, Hip circumference, Waist to Hip ratio), Biochemical (Hemoglobin using Drabki method, Clinical, and Dietary details (Food frequency, three day dietary record) were obtained from the subjects by appropriate methods.

**Statistical Analysis:**

The obtained details were coded and entered into Microsoft excel. The coded raw data were subjected to statistical analysis using Statistical Package for Social Science

(SPSS) version 20.0. Anthropometry, biochemical, clinical, dietary details were correlated and results were interpreted.

**RESULTS AND DISCUSSION**

Nutritional deficiency may impact both hair structure and hair growth. In our present study, hair loss is associated with deficiency of iron, protein and zinc with correlation coefficient values of .511, .461 and .176 respectively and this is also statistically significant at  $p < 0.001$ .

Hair follicles are made of cells that require hemoglobin. When there is no sufficient iron to produce hemoglobin, deficiency occurs and oxygen cannot be transferred to the cells for growth and repair. Iron is involved in several critical physiologic processes within the hair follicle, suggesting that iron deficiency could disturb hair synthesis<sup>13</sup>. Deficiencies of essential amino acids and nonessential are noted in participants with hair loss<sup>14</sup>. Zinc deficiency may lead to changes including hair loss and brittle hair. A study of 312 patients with male pattern hair loss, female pattern hair loss, showed that all groups had statistically lower zinc concentrations as compared to 30 healthy controls<sup>15</sup>.

In our study, Recurrent mouth ulcer is related to the deficiency of iron, zinc, vitamin B1, B2, B3, B6 and B12 with the correlation coefficient values of -.535, -.565, -.533, -.564, -.614, -.460, -.493 which is also statistically significant at  $p < 0.001$ . A riboflavin deficiency causes ariboflavinosis, which is manifested as cracked lips, inflammation of the tongue, and dryness or burning of the oral cavity<sup>16</sup>. Nutritional deficiency was the second common factor related with the condition.

In a study, it was suggested that moderate malnutrition, principally, a lack of protein and other micronutrients such as vitamins, zinc, and iron, limits the protective effect of saliva on the oral cavity, by manipulating its composition and amount<sup>17</sup>. Acanthosis nigricans is associated with increased calorie and fat consumption

in our study. It is also statistically significant at  $p < 0.001$  with coefficient correlation of .306 and .227 respectively. A study conducted by *Shiv Prakash* showed

that acanthosis nigricans was more in the patients with waist circumference of more than 90cm and was lesser in patients with waist circumference less than 90cm<sup>18</sup>.

**Table-1 : Impact of Nutrients Intake on Clinical Manifestation**

Nutrients	Clinical Manifestation	Correlation Coefficient	p value
Energy	Acanthosis nigricans	.306	<0.001**
	Constipation	-.218	<0.001**
Protein	Hairloss	-.176	<0.001**
	Muscle pain	-.252	<0.001**
	Bone/ joint pain	-.115	<0.001**
	Fatigue	-.315	<0.001**
Fat	Acanthosis nigricans	-.227	<0.024*
Fiber	Constipation	-.145	<0.001**
Calcium	Bone/ joint pain	-.094	<0.003**
	Fatigue	-.331	<0.001**
	Pica	-.364	<0.001**
Iron	Hair loss	-.511	<0.001**
	Dandruff	-.435	<0.001**
	Recurrent mouth ulcer	-.535	<0.001**
	Depression	-.354	<0.001**
	Irritability	-.327	<0.001**
	Poor concentration	-.509	<0.001**
	Fatigue	-.331	<0.001**
	Loss of appetite	-.225	<0.001**
	Pica	-.455	<0.001**
	Loss of taste	-.407	<0.001**
	Paleness of skin	-.524	<0.001**
Zinc	Hair loss	-.461	<0.001**
	Recurrent mouth ulcer	-.565	<0.001**
	Loss of appetite	-.285	<0.001**
	Loss of taste	-.419	<0.001**
Vitamin B1	Recurrent mouth ulcer	-.533	<0.001**
Vitamin B2	Recurrent mouth ulcer	-.564	<0.001**
Vitamin B3	Recurrent mouth ulcer	-.614	<0.001**
Vitamin B6	Recurrent mouth ulcer	-.460	<0.001**
Vitamin B12	Recurrent mouth ulcer	-.493	<0.001**
	Pica	-.344	<0.001**
Folic acid	Depression	-.407	<0.001**
	Recurrent mouth ulcer	-.502	<0.001**
	Poor concentration	-.461	<0.001**
	Paleness of skin	-.426	<0.001**
	Irritability	-.461	<0.001**
	Angular stomatitis	-.431	<0.001**
Vitamin C	Hairloss	-.384	<0.001**
	Easily plucked hair	-.332	<0.001**
	Dry skin	-.293	<0.001**

Note: \*\* denote 1% level significance; \*denote 5% level significance

Nutrition can play a key role in the onset as well as severity and duration of depression. Our study reported the impact of deficiency of iron on depression, irritability, and poor concentration with the correlation coefficient values of -.354, -.327, -.509. Omega-3 fatty acids, vitamin B (e.g., folate) and magnesium deficiencies have been linked to depression. A notable feature of the diets of patients suffering from mental illnesses is the severity in deficiency of these nutrients<sup>19</sup>. Iron deficiency can cause

depression, irritability, fatigue, and sleepiness, and it effects on quality of life<sup>20</sup>.

Pica was associated with inadequacy of iron and calcium in our study. The correlation coefficient found to be-.455 and -.364. A study conducted by *Diano Miao* showed that Pica was associated with 2.4 times greater odds of anemia (95% CI: 1.94–2.85,  $p < 0.001$ ), lower hemoglobin concentration and lower zinc concentration. In our study, iron and zinc deficiency is associated with loss of appetite and loss of taste. It is also statistically significant at

$p < 0.001^{21}$ . A study conducted by *Pisano* also showed that the zinc deficiency may lead to loss of appetite<sup>22</sup>.

**Table- 2: Impact of BMI on clinical manifestation**

Clinical Manifestation	Correlation coefficient	P value
Loss of appetite	-0.433	<0.001**
Poor concentration	-0.263	<0.001**
Irritability	-0.203	<0.001**
Depression	-0.082	0.009**
Goiter	0.470	<0.001**
Recurrent mouth ulcer	-0.140	<0.001**
Loss of taste	-0.262	<0.001**
Acanthosis nigricans	0.688	<0.001**

Note: \*\* denote 1% level significance

Increased or decreased BMI is involved in a number of clinical manifestations in our study. Loss of appetite (-0.433), loss of taste (-0.262), poor concentration (-0.263), irritability (-0.203), depression (-0.082), and recurrent mouth

ulcer (-0.140) had an inverse correlation with BMI which shows the chronic deficiency of energy intake and micro nutrient intake resulting in the above mentioned manifestation outcome. BMI also had a positive correlation with goiter (0.470) and acanthosis nigricans (0.688). Goiter due to hypothyroidism and symptom like acanthosis nigricans are due to elevated BMI.

A study conducted by *Bijay Khan* signifies that presence of acanthosis nigricans is an important indicator of central obesity and consequent metabolic disorders<sup>23</sup>. An interesting finding of *Ceonore* clarified the nature of the association between BMI and depression. They found a U-shaped trend in the association ( $p \leq 0.001$ )<sup>24</sup>.

**Table-3: Impact of increased Anthropometric measurements on Clinical Manifestations**

Anthropometric measurement	Clinical Manifestation	Correlation coefficient	P value
Waist Circumference	Acanthosis nigricans	0.440	<0.001**
	Goiter	0.313	<0.001**
Hip Circumference	Acanthosis nigricans	0.519	<0.001**
	Goiter	0.376	<0.001**
Waist to Hip Ratio	Acanthosis nigricans	0.106	0.001**
	Goiter	0.058	0.067

Note: \*\* denote 1% level significance

The analysis showed a positive association between the presence of Acanthosis nigricans and waist circumference ( $p < 0.001$ ), hip circumference ( $p < 0.001$ ). The association of Acanthosis nigricans and waist to hip ratio is not significant. The presence of acanthosis nigricans may contribute towards facilitating the early detection of conditions that increase the risk of overweight children and adolescents of developing cardio metabolic diseases in adulthood, thus permitting the timely implementation of intervention.

Goiter is a condition which is common in hypothyroidism. These hypothyroid subjects are also prone to overweight and increased waist circumference. The presence of Acanthosis nigricans was associated with higher BMI waist circumference<sup>25</sup>.

**Table-4: Impact of low hemoglobin on Clinical manifestation**

Clinical Manifestation	Correlation coefficient	'p' value
Hair loss	-516	<0.001**
Easily plucked	-527	<0.001**
Dry hair, dandruff	-456	<0.001**
Recurrent mouth ulcer	-583	<0.001**
Angular stomatitis	-416	<0.001**
Glossitis	-436	<0.001**
Depression	-414	<0.001**
Irritability	-360	<0.001**
Poor concentration	-554	<0.001**
Fatigue	-388	<0.001**
Pica	-561	<0.001**
Loss of appetite	-198	<0.001**
Loss of taste	-463	<0.001**
Paleness of skin	-541	<0.001**

Note: \*\* denote 1% level significance

The above table illustrates the impact of low hemoglobin on clinical manifestations in the present study.

Loss of hair and dry hair are commonly reported in our study. Micro nutrients namely iron and zinc are essential for hair growth. These nutrient deficiencies resulted in low hemoglobin which has an effect on hair loss, dry hair and easy plucking of hair with the correlation

coefficient value of -516, -456 and - 527. This is also statistically significant ( $p < 0.001$ ). Our study is also in accordance to the results of the study conducted by **Song Youn Park** in which he revealed that iron plays a certain role especially in premenopausal female pattern hair loss<sup>26</sup>.

There exists a wide prevalence of oral manifestations such as recurrent mouth ulcer, angular stomatitis and glossitis in the present study which resulted due to low hemoglobin status of the subjects. The correlation coefficient value found to be -583, -416, and -436, respectively. It is also statistically significant ( $p < 0.001$ ). Iron deficiency anemia patients had a significantly higher frequencies of all oral manifestation than healthy control which burning sensation of oral mucosa, lingual varicosity, dry mouth, oral lichen planus, and atropic glossitis were the five leading oral manifestations of iron deficiency anemia<sup>27</sup>.

In the present study, mood disorders are highly associated with low hemoglobin level. In the current study depression (-414), irritability (-360), and poor concentration (-554) are statistically significant ( $p < 0.001$ ) with low hemoglobin levels. Numerous studies conducted across the world shows that Iron deficiency anemia increases the risk of psychiatric disorders including mood disorders (depressive disorders, mood disorders), attention deficit hyperactivity disorder, autism spectrum disorders and developmental disorder<sup>28</sup>. Anemia reduces the learning power which causes academic dropout among the students<sup>29</sup>. There was a significant correlation between hemoglobin concentration and pictorial memory, optical memory and hematocrit, mean corpuscular hemoglobin with verbal memory. Increase of iron level led to increase of concentration and improvement of memory in the anemic patients<sup>30</sup>.

Pica is the craving and purposive consumption of non-food substances, it is a critical sign of iron deficiency, It is also an act or habit of eating non-food items such as stone, chalk, bricks, soap, paper, soil. In our

study, 94% of the subjects practicing pica were anemic. The correlation of pica with low hemoglobin is statistically significant ( $p < 0.001$ ). Since iron deficiency may cause glossal pain, it has been proposed that patients with anemia choose to chew ice for its analgesic properties<sup>31</sup>. Earlier investigators proposed that pica practices compensated for nutritional deficiencies such as iron or zinc, other theories suggest possible psychological problems, family stress, obsessive- compulsive disorder, or merely the enjoyment of taste and texture of the items being consumed<sup>32</sup>.

Wide prevalence of loss of taste, loss of appetite and paleness of skin are reported in our study. The correlation coefficient value found to be -463, -198, and -541. Low hemoglobin level has an inverse effect on these symptoms. A similar study conducted by **Gurram Sudha Rani** showed that appetite was less in anemic girls in both urban and rural area<sup>33</sup>. Another study conducted by **Kawalijit Kaur** revealed that anemia to be related with loss if normal color of the skin, lips, tongue, nail beds and blood vessels in the white of the eye<sup>34</sup>. Lethargy, lack of energy, apathy, fatigue, numbness, and loss of strength are few signs that teachers and parents noticed among anemic students<sup>35</sup>.

## CONCLUSION

Physical signs and symptoms of malnutrition can be valuable aids in detecting nutritional deficiencies. Protein and micro nutrient deficiency have been the major nutritional problems faced by developing countries such as India. The recommended dietary allowance (RDA) for protein and micro nutrients intake is not met by our study participants that causes nutritional deficiency and results in number of clinical manifestations.

Overweight and obese subjects manifested with acanthosis nigricans, whereas underweight subjects reported to have loss of appetite, loss of taste, poor concentration, irritability and recurrent mouth ulcer. Subjects with increased waist

circumference, hip circumference, and waist to hip ratio were presented with the symptoms of acanthosis nigricans and goiter.

The effect of low hemoglobin on clinical manifestation was observed in the present study. It demonstrated that low hemoglobin levels resulted in a number of manifestations such as hairloss, recurrent mouth ulcer, angular stomatitis, glossitis, depression, irritability, poor concentration, fatigue, pica, loss of taste, loss of appetite, paleness of skin, dry hair, and easy plucking of hair which was also significant at 1% level significant.

Sufficient nutrition intake, prevents manifestations of nutrition deficiencies. Students must be encouraged to consume wholegrains, dhals, lean meat, low fat dairy products, fresh vegetables, fruits and greens to prevent micro nutrient deficiencies. Consumption of empty calories rich foods like carbonated beverages, sugars must be prohibited to prevent non-communicable diseases. Thus it is essential for the college students to consume nutrient rich foods and avoid energy densed food to maintain adequate nutritional status and prevent deficiencies.

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