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Relation of BMI and Body Fat Percentage with Nutritional Status of Adolescents

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Abstract:

Aims: *Relation of BMI and Body Fat Percentage with Nutritional Status of Adolescents in first year medical students.*

Materials and Methods: *Study was carried out in Tertiary Care Hospital and Seth G S Medical College Parel Mumbai. 100 1st year M.B.B.S. students were selected for study group contains 50 males and 50 females. Studies carried out on adolescents are very limited and it is needed to assess the nutritional status of adolescents. An attempt has therefore been made in the present study to*

Conclusion: *From the present study it is concluded that 72% of females and 78% of males are well nourished; 8% of females and 6% of males are over nourished and 20% of females and 16% of males are under-nourished. Considering the consequences or morbidity and mortality associated with undernourishment; corrective steps in the form of improvement in dietary pattern should be undertaken and for over-nourishment; in addition to rectification of diet, more stress should also be laid on doing physical activity. For Adolescent: BMI- Cutt off points as suggested by WHO should be followed rather than following the adult BMI values as the adult BMI value give a high estimate prevalence of malnutrition.*

Keywords: ***PEP, BMI, Nutrition, Malnutrition, Anthropometry, Body composition, Skin-fold, thickness.***

Introduction

Food security, defined as the access for all people at all times to enough food for an active and healthy life, underpins the "food for all" initiative launched at the World Food summit in 1996.[1] In almost all the countries there are people who suffer from hunger and malnutrition; a pathological state resulting from too title consumption of essential nutrients, but the extent and the pattern differ substantially from country to country.

Protein energy malnutrition (PEM) is an imbalance between the supply of protein and energy and the bodies demand for them to optimal growth and function. Such an imbalance leads to wasting, stunting and underweight when energy intake is inadequate and to overweight and obesity, when it is excessive. There are over 200 million adults who are moderately of severely overweight of whom 58 million are in developing countries. WHO estimates that in developing countries about 245 million adults are moderately underweight and 93 million severely underweight. Growth in the number of severely overweight adults is expected to be double that of underweight adults during 1995-2025.[1]

For adults, even the most optimistic trend gives a global value for 2025 of 82 million for severely underweight and 131 million for moderately underweight, severe overweight prevalence in 2025 is estimated at 300 million adults.[2]

Adolescence is also a period of increased requirements. Rapid accretion of new tissue and other wide spread developmental changes are accompanied by increased nutrition requirement relative to childhood years. The prevalence of under nutrition in adolescents is considerably lower than that early childhood, and the need for anthropometry has seemed less pressing.

Anthropometry is especially important during adolescence because it allows the monitoring and evaluation of the hormone – mediated changes in growth and malnutrition during this period.

Nutrition: It is the science of food, the nutrients and other substances therein, their action, interaction and balance in relationship to health and disease, process by which organisms ingest, digest, absorbs, transport and utilize nutrients and dispose off their end products. Nutrients also are concerned with social economic, culture and psychological implication of food and eating.[3]

Nutritional Status: It is condition of health of an individual as influenced by utilization of nutrients which can be

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determined by information obtained through diet history, physical examination etc.[3]

Malnutrition: There are 2 forms of malnutrition

1. Under nutrient and
2. Over - nutrition.

The undermutrition is due to is due to inadequate intake of both qualitative and quantitative food which leads to depletion of muscle and fat component in the body. Those who are undermourished are very sensitive to various forms of infection and morbidity.[4] The degree of overmoutrition is due to intake of qualitative and quantitative food more than requirements, leading to heavy deposition of fat and muscle in the body. Those who are overmoutrition are most sensitive to heart attacks, high blood pressure, and diabetes etc.[4]

The relationship between weight and mortality has been shown to be J-shaped with an mortality in people with relatively low BMI. Immune competence is those with a low BMI; susceptible low - weight individuals may succumb to life - threatening disease. In young people, the dominant cause of reduction in body weight is a fall in blood intake; caused either by unavailability of sufficient food to meet energy needs on or by anorexia. It is therefore important that we screen adolescent properly and take necessary steps to prevent this.

Anthropometry: This deals with the physical characters of a person and states the condition of health of the subject. Following are the components of anthropometry.

(a) **BMI:** With the help of height and weight, Body mass index (BMI) can be calculated which gives an accurate estimation of body size and body compassion and helps in diagnosing presence / absence of obesity/ under nutrition.

Body composition: Estimation of gross body composition of human body is important tool for metabolic analysis and evolution of nutritional status. Behnke proposed partition of body into two parts: fat and lean body mass. Human body fat can be measured by densitometry analysis, body water measurement or measurement of subcutaneous fat. Equations for predicating total body fat or of body density from a combination of skin fold at different sites have been developed. In the present study % fat was measured by skin-fold thikness.[5]

Skin-fold thickness: It can be measured with the help of a caliper, wherein; fold of subcutaneous tissue is grasped, between thumb and forefinger and placed between arms of calipers which exerts constant tension at their point of content with skin. Thickness of subcutaneous tissue can then be read from dial of calipers.

Common sites measured are:

1. Triceps
2. Subscapular
3. Suprailiac
4. thigh

Either one or all of them are measured.

In the present study for females: Iliac crest and Triceps are measured and for males: Thigh and Scapula are measured and then % body fat is calculated with the help of formulas.[5] with the help of above factors, the present study is done to find out nutritional status of adolescents.

Materials and Methods

Study was carried out in Tertiary Care Hospital and Seth G S Medical College Parel Mumbai**.** 100 1st year M.B.B.S. students were selected for study group contains 50 males and 50 females. Studies carried out on adolescents are very limited and it is needed to assess the nutritional status of adolescents. An attempt has therefore been made in the present study to

1. Assess the Nutritional Status of Medical Students of 1st M.B.B.S. (adolescents) with the help the help of anthropometry.
2. To compare the Nutritional Status by finding out the prevalence of malnutrition according to adult BMI values and according to adolescent BMI value.

Anthropometry: Following anthropometric measurements were done

1. Height in cms
2. Weight in kg
3. Percentage fat with the help of calipers
4. BMI

Sample Size: The present study is carried out on 100 1st M.B.B.S. students of GSMC (50 males and 50 females) not suffering from any major illness.

Materials:

- Weighing scale for weight measurement
- A scale to measure height (stadiometer)
- Calipers to measure skin fold thickness.

Need and Significance of the Study:

Problem of malnutrition in adolescence can be a major problem and can affect gross national product. An attempt has been made to identify the problem of malnutrition (which includes both underweight and obesity) to that corrective steps could be taken in order to prevent this problem.

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Limitations of the Study:-

Nutritional status of an individual is assessed from information of 4 types[2]:

1. Diet history
2. Anthropometry
3. Clinical examination
4. Biochemical examination

Here due to time constraint, only anthropometry has used as a tool to assess the nutritional status.

Methods:

Standing Height: Body height is measures on a stadiometer. Subject stands erect without shoes and his back close to the calibrated stand. The top piece is pressed firmly on to subjects head. Height recorded in centimeters; correct to ½ cms.

Body weight: On a weighing machine, subject stands in his normal clothing with shoes off the legs, recorded in kgs; correct to ½ kg.

Body fat percentage: This was assessed by the skin fold thickness technique by using Lange skin calipers (Pressure calipers). For accurate skin fold measurments[5]; following instructions were followed:

- Measurement taken directly on skin, not through clothing.
- Skin fold picked up with one and measurement with skin calipers taken with the other hand.

Sites chosen in female's are[5]:

1. iliac crest
2. Triceps

Lliac crest: Locate a point over the top of the hip at the mid – axillary line (middle of armpit) and use a skin – fold that is in the diagonal plane.

Triceps: Locate a point halfway between the tip of the acromial process (bony projection on top of shoulder) and on the tip of the olecranon process (tip of elbow) with the elbow at 90 – degree angle. Then measure the skin – fold with the arm relaxed and hanging in extension.

Sites chosen in males are[6]:

1. Thigh
2. Scapula

Thigh: Locate a point in the anterior midline of the thigh, midway between the hip and knee joint. Place the body weight on the opposite leg so that the thigh muscle is in a relaxed state and use a vertical skin - fold.

Scapula: This skin fold is taken at the tip of scapula on a diagonal plane.

Calculation of percentage of body fat:

For females:

Body density:

1.764 - [0.00081 x skin fold thickness at iliac crest]
- [0.00088 x skin fold thickness at triceps]

Percentage of body fat:

$$\left(\frac{4.570}{Body\ density} 4.12\ x\ 100\right)$$

For males:

Body density:

1.1043 - [0.001327 x skin fold thickness at thigh]
- [0.001310 x skin fold thickness at scapulas]

Percentage of body fat:

$$\left(\frac{4.570}{Body\ density} 4.12\ x\ 100\right)$$

Body Mass Index: With the help of height and weight; Body Mass Index (BMI) can be calculated which gives an accurate estimation of body size and body composition and helps in diagnosing presence/ absence of obesity/ under nutrition.

Cut-off points used for adolescents.

1.	For under nutrition[7] :	in females	<16.87
2.	For under nutrition[7] :	In males	<17.80
	Grade I	in females	>25.85 but <30.72
3.	For under nutrition[7] :	In males	>26.36 but <30.66
	Grade II	in females	>30.72
		In males	>30.66

Statistical Analysis, Results and Discussion

Tables drawn from the available data are descriptive. Qualitative description of sets of clinical values involves measure of central tendency. Common measures of central tendency are mean, median and mode.[7]

Mean: it is arithmetic average of a set of values.

$$X = \frac{Total\ of\ all\ values}{No.\ of\ population}$$

In the present study, averages are calculated with the help of mean. The amount of spread or dispersion in a set of a data usually is measured by range of observations of standard deviation which is defined as square root of arithmetic mean of squared deviation of individual values from their arithmetic mean.

DOI: 10.23958/ijirms/vol03-i01/12

Table I: Profile of physical characters of Males and females:

Mean age	**18 years 6 months**	**18 years 6 months**
Mean height	168.95 ± 5.335 cm	159.3 ± 7.08 cm
Mean weight	59.76 ± 9.15 kg	52.65± 8.51 kg
Mean % body fat	16.716 ± 6.21 %	26.03 ± 4.082 %

Table I shows the following: Mean % body fat is 16.716% which is above the suggested upper limit for males i.e. 15%. Mean body fat % is 26.03% which is above the suggested upper limit for females i.e. 20%. Means % body fat is more in females than that in males. The findings in the present study correlate well with the findings of ***Luzzi AF and James W.P.T.***[8] study. In addition to be reason cited above probably women also have smaller muscle mass because their work capacity is less therefore they tend to develop more body fat than the lean muscle mass. They showed in their study on Definition of chronic energy deficiency is adults, showed that women have body fat % more than that in males. They found out that women have a greater fat mass than men at each level of BMI and the proportion of fat rises progressively in proportion to the BMI. Women, may however require greater energy stores since they have to sustain their reproductive functions.

James WPT[9] in his study of challenge of chronic energy deficiency, showed that under-nourished people have unusual body composition. He proposed that the compositional change in the form of more body fat may prove to be partial composition for a poor growth in lean body mass during adolescents. The finding in the present study also show that body fat percentage is more on both males and females; probably this is done as a partial compensation of poor lean body mass by the body and it can serve as a reservoir of energy in time of needs

Table II: Profile of BMI of females and Males according to cut-off values for adolescents, as suggested by WHO.[10,11]

	Female	Male
Well nourished	72%	78%
Over nourished	8%	6%
Under nourished	20%	16%

Table II shows 72% of females to be well nourished, 8% to be over nourished and 20% to be undernourished. 78% of males to be well nourished 6% to be over nourished and 16% to be undernourished. In the present study re have found out that obesity is present is 6% of males and 8% of females whereas undernourishment is found in 16% of males and 20% of females. Thus the major concern is still undernutrition and not overnutrition. Major concern now days is gives on obesity and its related morbidity but little attention is paid towards under nourishment which is still most prevalent even in urban population like the one studies hare. ***Awasthi P.***[12] on their study of Nutritional status assessment using Anthropometric measurement in Adolescents Girls of College of Home Science in Pantnagar, showed that only 4.3% of subjects were severe CED i.e. grade III CED. None of the subjects was found to be obese. ***Gordon AM*** [13] in his study of Cuban refugees showed that 25% of the subjects suffered from undernourishment mostly of Grade I. second grade CED was rare and cases of Grade III CED were not found. Obesity was found in 20% of subjects.

Table III: Profile of BMI for females, according to adult BMI values.

	Females		**Males**	
Well nourished	60%	12% Over nourished	76%	8% Over nourished
Grade I Obese	10%		8%	
Grade II Obese	2%		0%	
Grade I CED	10%	28% under nourished	10%	16% Under nourished
Grade II CED	14%		2%	
Grade III CED	4%		4%	

Table III shows 60% of females to be well nourished 12% to be over nourished and 28% to be under nourished. Comparison of BMI between adolescent and adult cut-off values (Refer Table II and III) shows that adult BMI value give high estimate of prevalence of malnutrition. And shows 76% of males to be Well nourished 8% to be Over nourished and 16% to be Under nourished.

BMI cut-off value for adolescents, according to WHO are:-

- >85th percentile BMI for age but <95th percentile BMI for age – person is possibly obese. This value for males corresponds to >26.36 but <30.66 and for females corresponds to <30.72.[12,13]

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- >95th percentile BMI for age: person is obese. This value for females according to >30.66 and for females corresponds to >30.72.[12,13]
- >5th percentile BMI for age: person is under nourished. This value for females according to >17.80 and for females corresponds to <16.87.[6]

Thus it is seen that adult BMI value gives a high estimate of prevalence of malnutrition. Therefore the cut-off value as suggested by WHO for adolescents should be followed because application of adult reference data to adolescents gives distribution of weight for categories of stature to be different for adults than for adolescents even at the same stature. For eg. At a stature of 165-167 cm median weight of adult men exceeds that of adolescent males by 15kg and median weight of adult women exceeds that of adolescent female by almost 7kg.

Conclusion

From the present study it is concluded that 72% of females and 78% of males are well nourished; 8% of females and 6% of males are over nourished and 20% of females and 16% of males are under-nourished. Considering the consequences or morbidity and mortality associated with undernourishment; corrective steps in the form of improvement in dietary pattern should be undertaken and for over-nourishment; in addition to rectification of diet, more stress should also be laid on doing physical activity.

For Adolescent: BMI- Cutt off points as suggested by WHO should be followed rather than following the adult BMI values as the adult BMI value give a high estimate prevalence of malnutrition.

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