ORIGINAL ARTICLE

An epidemiological comparative study of weight and height parameters for nutritional assessment of adolescents in a rural area of North India

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Abstract

Research Question: What is the simplest way to assess the nutritional status of adolescents? **Objectives:** (1) To compare and identify the most appropriate method for rapid assessment of nutritional status of rural adolescents using height and weight parameters. (2) To assess whether EHPA chart is superior over the conventional method of using BMI for the nutritional assessment of adolescents or not. **Study Design:** Cross-sectional study. **Study Setting:** Eight registered schools in the field practice area of Rural Health Training Center, Bilaspur, Department of Community Medicine, Muzaffarnagar Medical College, Muzaffarnagar, U.P., INDIA. **Sample size:** 467 i.e., all the school going rural adolescents of both sexes (11-19 yrs of age). Study variables: Height and weight. **Methodology:** The weight and height of all the study subjects was recorded by portable dial weighing machine and stadiometer respectively with due permission of the school principal. Age of subjects were recorded from the school register as on their last birthday. The data were subjected to comparision for nutritional assessment by using two study tools i.e., conventional BMI and EHPA chart. Statistical analysis: Proportion and Chi square test by using epi info statistical package. **Result:** A total of 467 adolescents were examined. By using conventional BMI, 93.79% of adolescents were classified as underweight and 4.06% as normal; however with the help of EHPA chart it was found that 38.97% adolescents were underweight and 58.67% were normal. **Conclusion:** Existing norms of using conventional BMI for assessing nutritional status of adolescents is inappropriate as far too many normal adolescents fall in undernourished category, whereas EHPA chart prevents such fallacies.

Key Words

Adolescent; nutritional status; conventional BMI; EHPA chart

Introduction

Adolescence is a period of transition between childhood and adulthood. It occupies a crucial and important place in the life of human beings whereby transition is characterized by rapid rate of growth [1, 2]. Adolescence is a significant period of human growth and maturation. This period is characterized by an exceptionally rapid rate of growth which exceeds only during fetal life and early infancy. Due to rapid accretion of new tissue and other wide spread developmental changes; nutritional needs are also more during this period of life cycle. However, inadequate diet and unfavorable environment in developing countries may adversely influence the growth and nutrition of adolescents.

This period is also known to be second opportunity of growth as it facilitates catch-up growth for children experiencing nutritional deficits during early life [3].

Adolescents contribute about one fifth of the total population and appraisal of the progress of a country in the field of health can be made from time to time with the help of studies on growth and development and ultimately nutritional status of adolescents. Numerous attempts have been made in the past five decades or more to utilize the data on body measurements for the assessment of nutritional status and the general health of children and adolescents in India [4].

IAP has taken the challenging task of looking after the growth assessment of adolescents especially that of girls that has now been identified as one of the key determinants of future low birth weight (LBW) babies. There are different methods and tools for assessing the growth among adolescents using separate age specific charts for boys and girls (NNB data), body mass index (BMI) for age percentile charts for boys and girls (NCHS data) and many others. No doubt, it is very confusing to use different charts in a single health card for adolescents, especially for the field health workers [5].

No concerted efforts have been made to establish definite norms for assessing the nutritional status of adolescents which proves to be accurate, rapid and simplest one, especially for the field workers. With every passing day we are observing changes in life style which not only includes urban population but also the roading suburbs and rural population. If we detect the malnutrition (obesity and under nutrition) in adolescents at an early age, then we can take remedial measures for the same. Later in life, treating malnutrition becomes difficult, because at this juncture it becomes difficult to modify one's lifestyle. Conventionally, BMI ≥ 18.5 Kg/m^2 is considered normal but many literature revealed that this cut off indicator is inappropriate and by using this cut off one would include far too many normal children as undernourished [6-11]. Workers engaged in this field have suggested < 15 Kg/m^2 as the cut off for underweight or borderline CED in growing children [12-13]. In late teens and adults when growth spurt is over, the conventional BMI cut off seem appropriate.

Considering the significance of above facts, a novel growth assessment chart, the ELIZ health path for adolescents and adults (EHPA chart) [Figure I], which claims to be easy and the simplest one was designed by Elizabeth KE *et al* [14]. In the present study we are putting our efforts to find out a rapid, accurate, simplest and acceptable method including EHPA chart for monitoring and assessing the nutritional status of adolescents.

Aims & Objectives

1. To compare and identify the most appropriate method for rapid assessment of nutritional status of rural adolescents using height and weight parameters.
2. To assess whether EHPA chart is superior over the conventional method of using BMI for the nutritional assessment of adolescents or not.

Material and Methods

A cross-sectional study was conducted in the field practice area of RHTC (Rural Health Training Center), Bilaspur, Department of Community Medicine, Muzaffarnagar Medical College, Muzaffarnagar, U.P. The study population includes all the 467 adolescents (both male and female) aged between 11-19 years, studying in the schools registered under RHTC. After taking due permission from the school Principals of eight different registered schools. Each school was visited individually for a period of two months (1st October to 30th November 2014). Age of each subject was recorded from the school register as on their last birthday. The weight and height were recorded by portable dial weighing machine and stadiometer with least count of 0.5kg and 0.5cm respectively. We compared the two tools for nutritional assessment i.e., EHPA Chart [Figure I] and existing conventional BMI [Figure II] for nutritional assessment of rural adolescents. The conventional BMI was calculated by the formula- Weight in kg/ height in m^2.

The EHPA chart which was designed and validated by Dr. K. E. Elizabeth was compared with the conventional BMI method. The normal range of conventional BMI has been taken as 18.5 – 24.99 Kg/ m^2. As per EHPA chart, those who are in the growing age group or up to a height of 150 cm, the normal BMI range is 15 – 22 Kg/m^2, > 22 Kg/m^2 indicates overweight and > 25 Kg/m^2 indicates obesity and < 15 Kg/m^2 indicates underweight. EHPA and conventional BMI data were subjected to comparison and was analyzed by using epi info statistical package and was statistically tested for suitable test of significance (Chi square test).

Results

Table 1 shows age and sex distribution of the study population and it was found that 327 (70.02%) of adolescents were males and rest 140 (29.98%) were females.

Table 2 depicts the distribution of study subjects in different categories of nutritional status as per conventional BMI and EHPA chart and it is evident that by using conventional BMI 93.79% of subjects fall under the category of underweight, whereas by using EHPA chart, only 38.97% lie under the same category. Surprisingly, only 4.06% subjects were found to be normal as per conventional BMI as compared to 58.67% while using EHPA chart. So, there is a huge difference and these differences were found to be statistically significant and proving that existing norms of using conventional BMI for assessing nutritional status of adolescents is inappropriate, as far too many normal adolescents falls in undernourished category, whereas EHPA chart prevents such fallacies.

Discussion

The present study is surprisingly consistent with the previous studies [5-9]. Conventionally, BMI 18.5-24.99 Kg/m^2 is considered as normal, but many studies have shown that BMI <18.5 Kg/ m2 as cut off indicator of CED (chronic energy deficiency) is inappropriate, 5, 7, 8 and only 6% of the adolescents has BMI >18.5, 9 which is also 6.21% (normal + overweight + obese are added up) in the present study [Table-2]. By using this cut off one would include far too many normal children as undernourished [Table-2] [5, 10, 11]. Research workers have suggested BMI <15 Kg/ m2 as cut off to denote underline and borderline CED in growing children 12-13 and <13 Kg/ m2 as severe CED [13]. In the late teens and adults when growth spurt is over, the conventional lower and upper cut off values of 18.5 and 24.99 respectively seem appropriate.

Adolescent growth is linked to the onset of puberty and various genetic, hormonal and nutritional factors. The stature of the parents is yet another issue to be considered in this respect. Thus, the normal variation in timing of growth spurt and puberty can lead to misdiagnosis of growth disorder [5]. Therefore, the existing age specific chart proves to be insufficient due to various reasons mentioned above.

In a study conducted by Elizabeth KE, about 67% of the adolescents were reported to be underweight as per the existing norms of conventional BMI and by using EHPA chart the same was found to be 11% only [5]. The current study is consistent with the above study in that it showed much more adolescents as underweight (93.79%) as per conventional BMI and only 38.97% of the same according to EHPA chart. Only 4.06% adolescents were found to be normal as per conventional BMI as compared to 58.67% by administering EHPA chart on the same set of subjects. All these findings were found to be statistically significant. In both the studies it is evident that the existing norms of using conventional BMI for assessing nutritional status of adolescents is inappropriate, as far too many normal adolescents falls in undernourished category, whereas EHPA chart prevents such fallacies. The individual variation in the proportion of underweight and normal subjects in both the studies may be attributable to the different study settings i.e., urban and rural. BMI 18.5Kg/m^2 corresponding to 12th percentile to denote underweight or CED has been reviewed by many workers, who have suggested it to be 15Kg/m^2 [8, 12, 13].

The concept of age and sex independence projected in the EHPA chart has been evaluated on the light of the International Obesity Task Force (IOTF) recommendations [5,7]. Thus the use of EHPA chart for both sexes and the lower and higher cutoff indicators selected are appropriate for a preliminary screening of large number of children and adolescents in the community setting [Figure-I]. However there is a need to study more on the influence of income, socio-economic status, religion and residence (urban/rural) on growth and physical development of Indian adolescents [4].

It is now evident from the present study that EHPA chart prevents far too many normal children to fall in undernourished category [Table-2]. EHPA chart is superior to conventional BMI for assessing nutritional status of adolescents as it is very simple to use and demonstrate, it incorporates both sexes, weight and height can be plotted in the same chart and BMI can be directly read from the right margin of the chart, it avoids tedious calculation of BMI, it depicts various curves denoting normal range, underweight, overweight (tending for obesity) and obesity. It can diagnose both underweight and obesity and also shows the desirable weight range for the stature of an individual, helpful for adults to maintain optimum body proportion and thus remain

fit and keep away from many of the life style diseases [5].

Adolescent nutritional assessment has not been given the attention as it deserves. In fact it is during the spurt in growth during adolescence that malnutrition can be remedied- a fact little recognized even today. Adolescent have very special and distinct needs, which can no longer be overlooked. It is also essential to invest in adolescents, as they are the future of the country.

Conclusion

- Existing norms of using conventional BMI for assessing nutritional status of adolescents is inappropriate, as far too many normal adolescents falls in undernourished category, whereas EHPA chart prevents such fallacies.
- Conventional method of using BMI for nutritional assessment is applicable for adults only, whereas EHPA chart is very helpful for the appropriate nutritional assessment of adolescents as well as adults.
- EHPA chart is appropriate and very helpful for a preliminary screening of a large number of children and adolescents in the fields.
- However for detailed evaluation of an individual child, the centile chart and age & sex specific data are recommended.
- EHPA chart can be easily used by health workers in the fields without consuming time.
- Finally, we conclude that EHPA chart is a better tool for the assessment of the nutritional status of adolescents and hence it is recommended for health workers also as it is the need of hour in the fields.

Recommendation

EHPA chart is very useful for the field health workers and should be used for quick nutritional assessment of adolescents.

Limitation of the study

The study setting is limited to the registered schools of RHTC Bilaspur only. A multi-centric study could have generated enough emphasis on our findings.

Relevance of the study

Adolescents are mostly the neglected section of the society and there is a need to re-think & re-design various adolescent nutritional programme. This hidden and relatively new approach (EHPA Chart) is a feasible tool in our set up to provide quick results for the same.

Authors Contribution

KM is responsible for designing, conduction, data collection of the study and overall manuscript write up. SK is responsible for monitoring of the execution of the study. JVS responsible for final approval of the manuscript. SD & SR are responsible for applying the statistical tests. RS helped in data collection and its interpretation.

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Tables

TABLE-1 DISTRIBUTION OF SUBJECTS BY AGE AND SEX

SEX	AGE (in years)									TOTAL No. (%)
	11 No. (%)	12 No. (%)	13 No. (%)	14 No. (%)	15 No. (%)	16 No. (%)	17 No. (%)	18 No. (%)	19 No. (%)	
M	116 (34.47)	79 (24.16)	36 (11.01)	72 (22.02)	19 (5.81)	04 (1.22)	- -	01 (0.3)	- -	327 (RP= 100.00) (CP= 70.02)
F	49 (35.00)	45 (32.14)	20 (14.28)	18 (12.86)	05 (3.57)	02 (1.43)	- -	- -	- -	140 (RP= 100.00) (CP= 29.97)
Total	165 (35.33)	124 (26.55)	56 (11.99)	90 (19.27)	24 (5.14)	06 (1.28)	- -	01 (0.21)	- -	467 (RP= 100.00) (CP= 100.00)
(RP = Row Percentage; CP = Column Percentage)										

TABLE-2 DISTRIBUTION OF SUBJECTS IN DIFFERENT CATEGORIES OF NUTRITIONAL STATUS AS PER CONVENTIONAL BMI AND EHPA CHART

Categories of Nutritional Status	Conventional BMI No (%)	EHPA chart No. (%)	Chi-square test (p-value)
Under Weight	438 (93.79)	182 (38.97)	Highly Significant $p < 0.001$
Normal	19 (04.06)	274 (58.67)	Highly Significant $p < 0.001$
Overweight	09 (01.92)	01 (00.21)	Significant $p < 0.05$(Yates corrected)
Obese	01 (00.21)	10 (02.14)	Significant $p < 0.05$ (Yates corrected)
Total	467 (100.00)	467 (100.00)	

Figures

FIGURE I EHPA CHART- THIS CHART IS APPLICABLE TO BOTH SEXES. PLOT THE HEIGHT ON THE X-AXIS & THE WEIGHT ON THE Y-AXIS AND THEN DIRECTLY READ THE BMI FROM THE RIGHT MARGIN

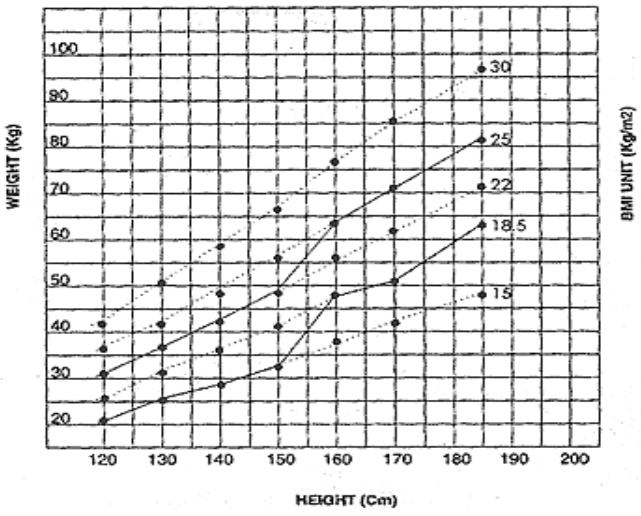
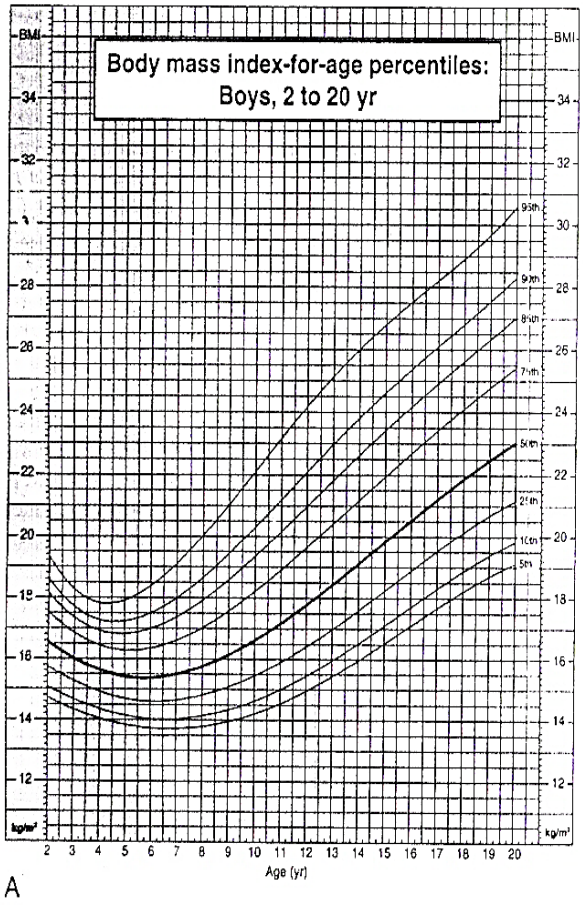
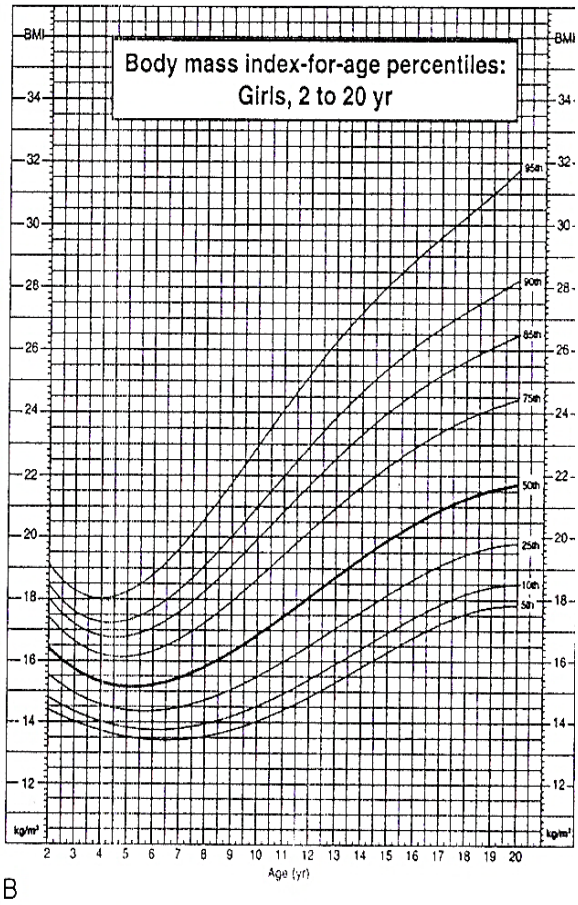


FIGURE II BODY MASS INDEX (BMI) PERCENTILES FOR BOYS (A) AND GIRLS (B) AGE 2-20 YRS. (OFFICIAL CENTERS FOR DISEASE CONTROL {CDC}. GROWTH CHARTS. 85TH-95TH PERCENTILE IS "AT RISK FOR OVERWEIGHT"; >95TH PERCENTILE IS "OVERWEIGHT"; < 5TH PERCENTILE IS "UNDERWEIGHT"



A



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