RESEARCH PAPER

Body Mass Index Quick Screening Tool for Indian Academy of Pediatrics 2015 Growth Charts

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Objective: To develop gender-specific graphic tool in which BMI cut offs can be read from height and weight, without need for calculating BMI and to validate the tool against Indian Academy of Pediatrics (IAP) 2015 BMI charts. **Methods**: Validation of tool was performed using de-identified data on children from school health surveys. **Results**: For detection of overweight and obesity, the BMI tool had sensitivity of 95.7% and specificity of 85.7% for boys, and 95.7% and 89.7% for girls, respectively. For underweight, sensitivity of 100% for boys and girls, and specificity of 88.9% for boys and 82.4% for girls was observed. **Conclusion**: We present a graphic BMI tool for screening for underweight, overweight and obesity, which complements the existing IAP charts.

Keywords: *Diagnosis, Growth chart, Obesity, Overweight, Underweight.*

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In recent times, while undernutrition is common in India [1], childhood obesity is an important health problem in urban areas, and seen commonly in older children and adolescents than younger children [2]. Early recognition of obesity is important to prevent adverse health consequences in adulthood such as hypertension and type 2 diabetes [3]. Further, undernutrition during adolescence can potentially retard adolescent growth spurt [4]. Indian Academy of Pediatrics (IAP) Guidelines provide body mass index (BMI) charts for Indian children to screen for under or over-nutrition [5]. BMI needs to be computed and then plotted on a growth chart. However, in a busy pediatric out-patient clinic, calculating BMI is time consuming and is often omitted [6]. BMI may not be plotted and hence overweight and underweight may be missed. Thus, there is a need to create a screening tool based on height and weight that eliminates need for BMI calculation and helps pediatricians rapidly screen for overweight, obesity and underweight. The objective of present study was to develop a gender-specific graphic tool in which BMI cut offs can be read from height on *X*-axis and weight on *Y*-axis, without the need to calculate BMI.

METHODS

The health-related risks of obesity such as metabolic syndrome are more common after 10 years of age or at the onset of puberty and likewise recommendations for screening for metabolic syndrome [7-9]. We therefore designed the BMI tool for use from 8 years. The mean value of height, weight and cut-offs for underweight, overweight and obesity were used from the IAP charts [5] to design the tool. Ethics approval for the study was obtained from the institutional ethics committee. The height range for boys and girls for the age group of 8-18 years was plotted on the *X*-axis. Based on the BMI cut off value for that particular age the corresponding weight to a particular height was calculated and plotted on the secondary *Y*-axis (Microsoft Excel 2015). Thus, height was plotted on the *X*-axis, weight on the *Y*-axis and three lines *viz*, for underweight, overweight and obesity were constructed on secondary *Y*-axis. The meeting point of the two lines gives the BMI. Depending on where the BMI point lies, child may be classified as being, obese, overweight, normal weight or underweight. If plotted reading falls below lowest line the child is underweight, if it is between underweight and overweight lines, the child has a BMI within reference range, if the reading falls between overweight and obese lines the child is overweight, and if above obese line, the child is considered obese. Separate tools were created for both genders.

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Sample size was calculated using external prognostic modeling [10] and was recommended to be more than 200. The tool was validated on de-identified data from a health survey [11]. Data were distributed over BMI categories as per the IAP charts into underweight, within reference

range, overweight and obese, and used to test sensitivity and specificity of BMI tool. Data on height and weight from validation data set were plotted on BMI tool and simultaneously on the IAP BMI charts. The number of children classified as underweight, within reference range, overweight and obese by the tool and IAP charts was noted. Sensitivity and specificity of the tool against IAP charts was computed (SPSS 25).

RESULTS

Data on 221 (112 boys) children age 8-18 years were used. The gender-wise BMI screening tools are illustrated in ***Fig*. 1** and **2**.

For detection of overweight and obesity in comparison with IAP charts, sensitivity was 95.7% for both boys and girls, whereas specificity was 85.7% for girls and 89.7% for boys. For detection of underweight, sensitivity was 100% for both genders and specificity was 88.9% for boys and 82.4% for girls.

DISCUSSION

We have presented a graphic tool based on IAP growth charts in which BMI can be read by plotting height and weight without the need to calculate BMI. The tool demonstrated high sensitivity and specificity for screening children for underweight, overweight and obesity, when tested against IAP BMI charts.

The limitations of the tool are that it is likely to categorize children wrongly at extreme ends of height for age, thus, too tall and very short children may be wrongly classified. The tool cannot be used in children younger than 8 years, and larger studies with a bigger sample size are required for validation and generalization of the tool.

In a study where questionnaires were sent to Ministries of Health of 202 countries, authors found that growth charts were mainly used for children from 0-5 years, and covered birth to adolescence in only 29% [12]. More than half of the countries, including 18 Asian countries, used weight for age charts instead of BMI charts [17]. In a questionnaire-based study to assess usage of growth charts, over two-third of doctors reported a positive attitude towards monitoring of growth; how-ever, perception of high workload was associated with lower usage of growth charts [8]. There are fewer preventive visits to hospitals as children get older [13]. These reports thus underline the importance of devising simple graphic tools to assess nutritional status for use in busy clinical settings.

A similar unisex chart was proposed by Elizabeth, *et al*. [14] in 2001 based on the International Obesity Task Force cut-offs [15], which may not be appropriate for Indian children at present. Unisex charts may not be appropriate as girls stop growing earlier than boys. The tool designed in the current study may be used in conjunction with IAP charts, and the cut-offs for BMI used are more appropriate for Asian Indian children, who have a higher body fat for a given BMI. However, it is important to remember that this is a quick screening tool and children who are found to be abnormal on the tool or at borderline of categories should be rechecked on the IAP BMI charts after calculating the BMI with standard formula.

To conclude, we present a graphic BMI tool for screening for underweight, overweight and obesity to complement existing IAP charts. The tool is gender specific and is based on height and weight, which

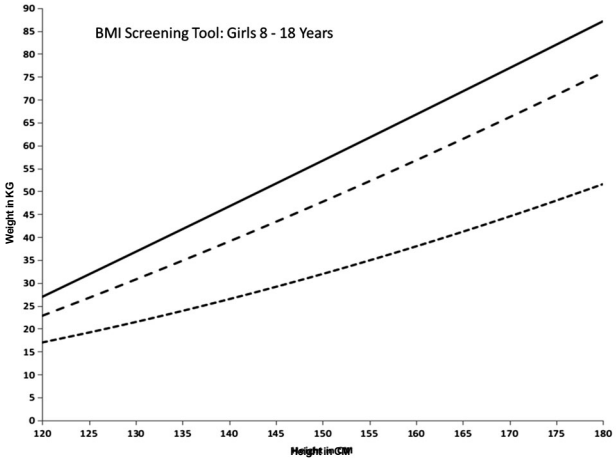

Fig. 1 *Body mass index screening tool for girls aged 8-18 years.*

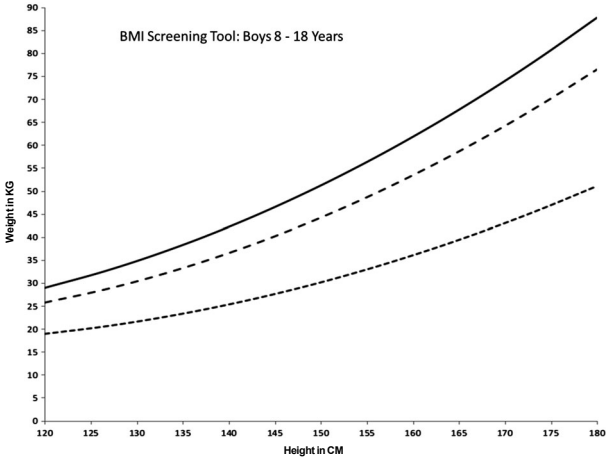

Fig. 2 *Body mass index screening tool for boys aged 8-18 years.*

WHAT THIS STUDY ADDS?

A body mass index (BMI) look-up tool using height and weight has been presented for screening for overweight, obesity and underweight in children aged between 8 and18 years.

eliminates the need for calculation of BMI, and may help pediatricians to rapidly screen for perturbations in BMI in a busy clinical setting.

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