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Validity of BMI as a measure of obesity in Australian white Caucasian and Australian Sri Lankan children

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Abstract

Background: Body mass index (BMI) is used to diagnose obesity. However, its ability to predict the percentage fat mass (%FM) reliably is doubtful. Therefore validity of BMI as a diagnostic tool of obesity is questioned.

Aim: This study is focused on determining the ability of BMI-based cut-off values in diagnosing obesity among Australian children of white Caucasian and Sri Lankan origin.

Subjects and methods: Height and weight was measured and BMI (W/H^2) calculated. Total body water was determined by deuterium dilution technique and fat free mass and hence fat mass derived using age- and gender-specific constants. A %FM of 30% for girls and 20% for boys was considered as the criterion cut-off level for obesity. BMI-based obesity cut-offs described by the International Obesity Task Force (IOTF), CDC/NCHS centile charts and BMI-*Z* were validated against the criterion method.

Results: There were 96 white Caucasian and 42 Sri Lankan children. Of the white Caucasians, 19 (36%) girls and 29 (66%) boys, and of the Sri Lankans 7 (46%) girls and 16 (63%) boys, were obese based on %FM. The FM and BMI were closely associated in both Caucasians ($r = 0.81$, $P < 0.001$) and Sri Lankans ($r = 0.92$, $P < 0.001$). Percentage FM and BMI also had a lower but significant association. Obesity cut-off values recommended by IOTF failed to detect a single case of obesity in either group. However, NCHS and BMI-*Z* cut-offs detected cases of obesity with low sensitivity.

Conclusions: BMI is a poor indicator of percentage fat and the commonly used cut-off values were not sensitive enough to detect cases of childhood obesity in this study. In order to improve the diagnosis of obesity, either BMI cut-off values should be revised to increase the sensitivity or the possibility of using other indirect methods of estimating the %FM should be explored.

Keywords: *body mass index, obesity, children*

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Introduction

Amidst the global epidemic of adult obesity, childhood obesity is also on the rise. This is not confined to the industrialized countries but also to many developing countries, especially in Asia, which are facing a major nutritional transition (Barrios et al. 1997, WHO 2000).

Obesity is identified as a disease in its own right, as well as a major risk factor for many non-communicable diseases such as hypertension, non-insulin dependent diabetes mellitus (NIDDM) and coronary vascular diseases. Moreover, the psychological effect of obesity is a major problem in older children and adolescents. The long-term consequences of childhood obesity are its persistence into adulthood with the associated health risk factors (WHO 2000).

By definition, obesity is the presence of excessive body fat associated with high morbidity (WHO 2000). However, the amount of body fat associated with morbidity is debatable. Several studies have been conducted to determine the percentage body fat that is associated with non-communicable disease risk factors, with figures varying between 20% and 30% in both sex (Lohman 1992, Williams et al. 1992, Dwyer & Blizzard 1996).

Although strictly speaking, obesity should be diagnosed based on the percentage fat mass (%FM), the methods available for *in vivo* assessment of %FM are either expensive or time consuming and cumbersome to patients. Of epidemiological interest, various anthropometric measures such as skin-fold thickness, body mass index (BMI) and weight for height ratios have been used as indirect measures of obesity. Of these measures, BMI has a clear relationship with body fat mass in adults (Gallagher et al. 1996) and children (Hannan et al. 1995, Goran et al. 1996, Pietrobelli et al. 1998) and is a convenient measure to perform in both field and clinical settings. However, the BMI cut-off values that would represent the %FM associated with non-communicable disease risk factors are not well defined. In adults a BMI of over $30.0\,\mathrm{kg\,m^{-2}}$ was set as the cut-off limit for the diagnosis of obesity (WHO 2000). However, producing a general cut-off value for all ages and sexes in children is not possible as BMI varies with age in both sexes. To overcome this, the Center for Disease Control/National Center for Health Statistics (CDC/NCHS 2000) as well as the British Child Growth Foundation (Cole et al. 1995), developed population-based gender-specific centile charts for BMI. A BMI above the 95th centile was considered as a cut-off limit for obesity in children (Barlow & Dietz 1998). The International Obesity Task Force (IOTF), using a worldwide representative sample of children, derived age- and gender-specific obesity and overweight cut-off values which are equivalent to a BMI of $30\,\mathrm{kg\,m^{-2}}$ at 18 years of age (Cole et al. 2000). Although there are several BMI cut-off values defined to diagnose obesity, scientists and clinicians are yet to agree on a definite method.

The ability of BMI to diagnose obesity and overweight accurately, across ethnic groups has also been questioned (Misra 2003). It poorly predicted the %FM associated with health risk across different ethnic groups as well as within the same ethnic group living in different socio-economic environments (Deurenberg et al. 1998). This has led to a debate as to whether ethnic-specific BMI cut-offs should be defined to diagnose overweight and obesity (Misra 2003) or indeed whether population-specific cut-offs should be used across each country (Stevens 2003).

This study aims to contribute to that debate by determining the validity of commonly used BMI cut-off values in detecting obesity among Australian children of white Caucasian and Sri Lankan origin.

Materials and methods

Subjects

Five to 14.99-year-old healthy male and female Australian Caucasian children and Sri Lankan migrant children living in Brisbane, Australia for more than 2 years were recruited. Children who had been ill during the preceding 2 weeks of conducting the test or were undergoing any special physical training that would alter their body composition were excluded. Subjects were contacted via newsletters and community centres and the procedure was explained to both parents and children. Informed written consent from parents and assent from the children were obtained. The study was conducted at the Body Composition Laboratory of Children's Nutrition Research Centre at the Royal Children's Hospital, Brisbane. The Medical Research Ethics Committee of the University of Queensland and the Ethics Committee of Royal Children's Hospital approved the study.

Anthropometry

Height was measured using a wall-mounted stadiometer (Holtain Instruments Ltd, Crymmych, UK) to the last completed 0.1 cm after keeping heals, buttocks, shoulders and occiput in the vertical plane and head in Frankfurt plane. Weight was measured with minimal lightweight clothing to the closest 100 g, using an electronic weighing scale (Tanita BWB-600®, Wedderburn Scales, Australia). BMI was calculated by weight/height^2 (kg m^{-2}).

Measurement of %FM

Total body water (TBW) was measured by isotope dilution method using deuterium in the form of water (D_2O). Initially a sample (10 ml) of urine was collected in a screw-cap bottle. This was used to determine the basal deuterium level in the body. A 10% D_2O dose of 0.5 g per kg body weight was given orally and the dose was measured to 0.01 g (Bell et al. 1998). A second sample of urine was collected 4–6 h after administrating the deuterium dose thus allowing equilibration with body water compartments. D_2O levels in urine were measured using isotope ratio mass spectrometry as described elsewhere (Halliday & Miller 1977). From TBW the fat free mass (FFM) and hence fat mass (FM) was calculated using age- and gender-specific constants for the water content of FFM (Lohman 1989) after the dilution space was adjusted for the exchange of deuterium with non-aqueous hydrogen (Schoeller 1996).

$$\mathrm{FFM} = \frac{\mathrm{TBW}}{\text{Percent water in FFM}} \tag{1}$$

The absolute fat mass was calculated by subtracting FFM from weight, based on the two-compartment body composition model. Fat mass index (FMI) was calculated by FM/height^2 (kg m^{-2}). Percentage body fat associated with obesity-related cardiovascular risk factors were considered to be 20% for boys and 30% for girls (Dwyer & Blizzard 1996). Therefore criterion diagnosis of obesity was based on the above %FM for the respective gender groups, assessed by isotope dilution method using a two-compartment body composition model.

In addition to this, obesity was diagnosed using three other BMI-based methods. They were the IOTF BMI cut-off values (Cole et al. 2000), CDC/NCHS (2000) BMI centile charts and British Growth standards BMI-*Z* scores (Cole et al. 1995). For each gender, IOTF has published BMI cut-off values for obesity and overweight for each half-year of age from 2 to 18 years. This corresponds to the adult BMI of 30 $kg\,m^{-2}$. Obesity was diagnosed if the BMI was above the cut-off value for each given age and sex. If the age of the studied subject was not exactly of the age described in the chart, the BMI cut-off values were calculated by linear interpolation for each child according to their exact age (in decimal years) at measurement. For the CDC/NCHS BMI centile chart, a BMI above the 95th centile for age and gender was considered as obese while subjects with BMI-*Z* scores above 2 were diagnosed as obese, according to the British Growth standards.

Statistical analysis

The relationships between BMI and FM, BMI and %FM, BMI-*Z* and FM, and BMI-*Z* and %FM were evaluated via correlation.

Validity and accuracy of BMI indicators in the diagnosis of obesity were evaluated by calculating sensitivity, specificity, positive predictive value and efficiency, relative to true obesity diagnosed by absolute %FM, using a 2×2 table (Himes & Bouchard 1989). Sensitivity is the proportion of truly obese subjects identified correctly as obese by the indicator (true positives). Specificity is the proportion of truly non-obese subjects identified correctly as non-obese by the indicator (true negatives). The positive predictive value of a test is the proportion of those who are identified as positive (obese) by the indicator who are truly positive (obese), i.e. the proportion that is truly positive (obese) of the total that had been diagnosed as positive (obese) by the indicator. The efficiency is the proportion of all subjects that are being diagnosed correctly as positive (obese) and negative (non-obese) by the indicator, i.e. the total of true positives and true negatives as a proportion of the total group.

Multiple linear regression analysis was used to investigate the role of ethnicity on the relation between BMI-*Z* score and %FM. Percentage FM was considered as the dependent variable. BMI-*Z* score, a dummy binary variable to identify the ethnic origin (Sri Lankan as 1 and Caucasian as 0), and their interaction term (i.e. the product of BMI-*Z* score and dummy binary variable for ethnic origin) were considered as independent variables (Davies & Cole 2003). After defining the variables, two multiple linear regression analysis were carried out. The first analysis was performed taking BMI-*Z* and the dummy variable as independent variables. Secondly, an interaction term was included as the third independent variable (Table V). Significance was considered at $P < 0.05$, and was based on the two-tailed *t*-test. Data were analysed using EpiInfo version 3.01 (CDC 2003) statistical computer package.

Results

Ninety-six Australian white Caucasian and 42 Australian Sri Lankan children were studied. All white Caucasians were born in Australia and had not lived overseas. Of the Sri Lankans, 25 (60%) were born in Australia and others had been living in Australia for more than 3 years (mean duration 6.8 ± 2.4 years).

Table I shows some basic characteristics of the subjects. The mean ages of all four groups were similar. The Australian Sri Lankan girls were heavier, taller and had a higher BMI than their white Caucasian counterparts. Moreover the body FM, %FM, FFM and FMI were higher among Sri Lankan girls. However, the differences were not statistically significant. The white Caucasian boys had a significantly higher weight, height and BMI compared to

Table I. Physical characteristics of the study population.

	Male		Female	
	Caucasian	Sri Lankan	Caucasian	Sri Lankan
n	44	27	52	15
Age (years)	9.7 ± 2.2	9.1 ± 3.5	9.2 ± 2.3	9.6 ± 2.6
Weight (kg)	36.1 ± 12.6	28.7 ± 9.5*	31.8 ± 10.2	34.1 ± 14.0
Height (cm)	140.6 ± 14.5	131.8 ± 14.6*	134.4 ± 14.7	135.5 ± 16.2
BMI (kg m^{-2})	17.7 ± 2.7	16.3 ± 2.7*	17.2 ± 2.4	17.7 ± 2.6
FM (kg)	8.5 ± 4.6	6.9 ± 4.6	9.2 ± 4.6	10.2 ± 5.5
%FM	23.2 ± 7.6	22.9 ± 8.7	27.9 ± 8.1	29.0 ± 6.0
FFM (kg)	27.6 ± 9.6	21.8 ± 6.6	22.6 ± 6.9	23.9 ± 9.1
FMI (kg m^{-2})	4.2 ± 1.7	3.9 ± 2.1	4.9 ± 2.0	5.3 ± 1.8
BMI-*Z*	0.44 ± 0.95	−0.34 ± 1.58*	0.10 ± 1.01	0.10 ± 1.15

*$P < 0.05$ between Caucasians and Sri Lankans within the gender.

their Sri Lankan counterparts. Although the white Caucasian boys also had a higher FFM, FM, %FM and FMI, they were not significant.

The correlation coefficient was calculated for BMI and FM, and BMI and %FM, for each sex of each ethnic group (Table II). The correlation was highest between BMI and FM and many of the correlations were statistically significant. However in many cases the variance accounted for by BMI was low and therefore potentially of limited practical use. For example, the variance accounted for in the relationship between the BMI-*Z* and %FM was only 23%.

BMI changes with growth from infancy through childhood to adolescence. Therefore to overcome the influence of age and gender on BMI, we used BMI-*Z* scores of each subject instead of BMI and measured the correlation between BMI-*Z* and each of the indices of adiposity, i.e. FM, %FM and FMI (results are shown in Table II). Of all the associations between BMI-*Z* and indices of adiposity, the association between BMI-*Z* and FMI was the strongest.

Table III shows the number of individuals diagnosed as obese based on the four different criteria. A higher proportion of boys in each group had a %FM that would be associated with adverse health outcomes (obese), compared to the females in their respective groups. The IOTF BMI based cut-off values failed to detect a single case of obesity. However, CDC/NCHS and BMI-*Z* score cut-off values detected cases of obesity in each group with a low sensitivity. We also calculated the number of subjects that were overweight using IOTF and CDC/NCHS (between 85th and 95th centiles for age and sex) cut-off values (Table III). The numbers diagnosed as overweight and obese combined together were still well short of the total number diagnosed as obese based on the criterion method in each group. Table IV shows the sensitivity, specificity, positive predictive value and efficiency for each BMI-based obesity diagnostic cut-off value.

Diagnosis of obesity is based on percentage body fat. Therefore we studied the influence of ethnicity on the association between BMI-*Z* and %FM. A scatter diagram between BMI-*Z* and %FM for each ethnic group is shown in Figure 1 with the best line of fit for each data set. Firstly, multiple linear regression analysis was performed for all subjects pooled together with %FM as the dependent variable, and BMI-*Z* and a dummy binary variable for ethnic origin as independent variables (Table V). The *F*-test for a dummy binary variable was not significant, denoting that the intercepts of the two regression lines were not significantly different. Secondly, multiple linear regression was calculated by

Table II. Correlation coefficient (r) and level of significance of the relationship between BMI and other indices of body composition.

	Caucasian		Sri Lankan	
	r	p	r	p
BMI vs FM				
Whole group	0.81	<0.001	0.92	<0.001
Male	0.82	<0.001	0.91	<0.001
Female	0.85	<0.001	0.94	<0.001
BMI vs %FM				
Whole group	0.42	<0.001	0.68	<0.001
Male	0.32	<0.05	0.77	<0.001
Female	0.63	<0.001	0.53	<0.05
BMI vs FMI				
Whole group	0.71	<0.001	0.87	<0.001
Male	0.64	<0.001	0.89	<0.001
Female	0.84	<0.001	0.85	<0.001
BMI-*Z* vs FM				
Whole group	0.61	<0.001	0.73	<0.001
Male	0.69	<0.001	0.71	<0.001
Female	0.58	<0.001	0.85	<0.001
BMI-*Z* vs %FM				
Whole group	0.48	<0.001	0.64	<0.001
Male	0.46	<0.001	0.66	<0.001
Female	0.64	<0.001	0.59	<0.001
BMI-*Z* vs FMI				
Whole group	0.69	<0.001	0.77	<0.001
Male	0.69	<0.001	0.76	<0.001
Female	0.78	<0.001	0.85	<0.001

Table III. Cases of obesity and overweight diagnosed by the different criteria.

	Male		Female	
	Caucasian	Sri Lankan	Caucasian	Sri Lankan
Obesity				
%FM	29 (66%)	16 (59%)	19 (36%)	7 (46%)
IOTF	0	0	0	0
CDC	1	2	4	1
BMI-Z > 2 SD	2	2	1	1
Overweight				
IOTF	8	5	10	2
CDC	8	4	6	1

adding the interaction term as the third independent variable. The F-test for interaction term was not significant; hence the slopes of the two regression lines were not significantly different. This indicates that ethnic origin had not influenced the association between BMI-Z and %FM in this study. A similar analysis was done using BMI instead of BMI-Z (data not shown) and the results showed that ethnic origin did not influence the association between BMI and %FM.

Table IV. Validity of BMI as an indicator of obesity (%).

		IOTF (%)	CDC (%)	BMI-Z >2 SD (%)
Male				
Caucasian	sensitivity	0	3.5	6.9
	specificity	100	100	93.0
	predictive value	α	100	66.0
	efficiency	34.0	36.4	36.0
Sri Lankan	sensitivity	0	12.5	12.5
	specificity	100	100	100
	predictive value	α	100	100
	efficiency	41.0	48.0	48.0
Female				
Caucasian	sensitivity	0	20.0	5.2
	specificity	100	100	100
	predictive value	α	100	100
	efficiency	61.5	69.2	65.5
Sri Lankan	sensitivity	0	14.3	14.3
	specificity	100	100	100
	predictive value	α	100	100
	efficiency	53.0	60.0	60.0

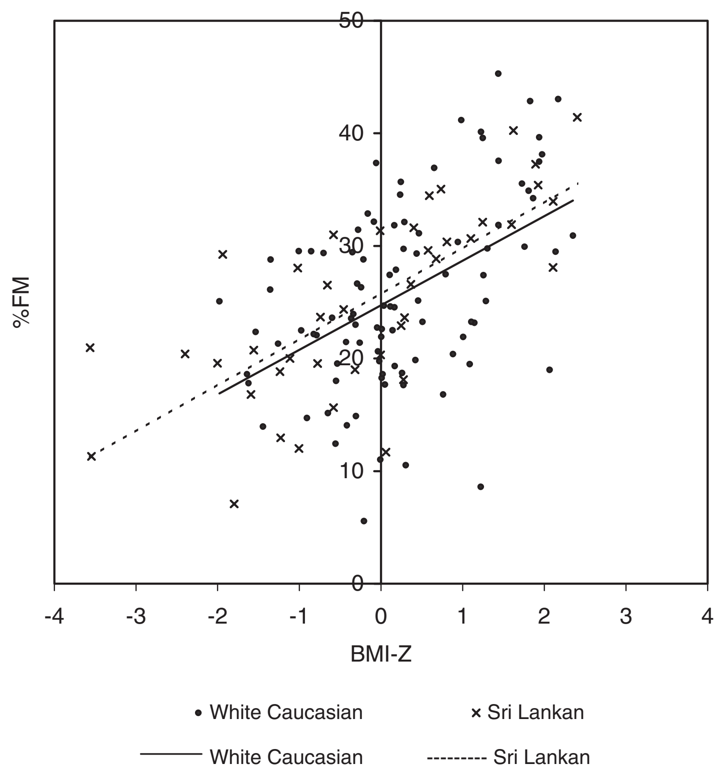

Figure 1. Scatter diagram for BMI-Z and %FM for each ethnic group with the best line of fit for each data set.

Table V. Multiple regression analysis to assess the influence of ethnic origin on the relationship between %FM and BMI-*Z* score.

Predictor	Coefficient	SE	*F*-test	*p*
First analysis				
Constant	24.679	0.728	1150.61	<0.0001
BMI-*Z*	4.118	0.561	53.86	<0.0001
Binary dummy variable	−0.238	1.294	0.034	0.85
Second analysis				
Constant	24.720	0.739	1118.85	<0.0001
BMI-*Z*	3.995	0.723	29.92	<0.0001
Binary dummy variable	−0.317	1.317	0.058	0.81
Interaction term	0.414	1.152	0.129	0.72

Binary dummy variable for ethnic origin: 1, Sri Lankan; 0, Caucasian.

Discussion

Life course epidemiologists believe in the concept of a chain of risk, which denotes that adversity in early life may persist to adult life with adverse outcomes (Ferraro et al. 2003). Fatness in childhood and adolescence persists into adulthood. However, even though the risk is less in younger age groups, obesity diagnosed in a child at 7 years will have an elevated relative risk, of about three, of becoming obese in adulthood (Power et al. 1997). Childhood obesity is associated with increase adult morbidity and mortality, mainly in men, from coronary heart disease, atherosclerosis and colorectal carcinoma (Power et al. 1997). Furthermore, obesity in childhood is associated with gallstones, hepatitis, sleep apnoea, raised intracranial pressure, endocrine disturbances and skeletal deformities. Moreover, the psychosocial effects such as low self-esteem and discrimination may lead to many adverse economic and emotional outcomes, in these individuals (Must & Strauss 1999).

Scientists and clinicians are yet to agree on the exact limits of percentage body fat that are associated with adverse health effects. Lohman (1992) and Williams et al. (1992) showed that a %FM over 25% and 30% in boys and girls, respectively, was associated with detrimental cardiovascular risk factors and hence proposed that obesity should be diagnosed based upon percentage body fat levels. Dwyer and Blizzard (1996) studied a cohort of Australian children and found that detrimental cardiovascular risk factors were associated with a percentage body fat of 20% and 30% in boys and girls, respectively, suggesting that obesity should be defined based on these values (Dwyer & Blizzard 1996).

It is well accepted that BMI, which is the ratio between weight and height^2, does not always reflect the percentage body fat accurately. Furthermore, even in the same population body composition can change with time and BMI may not be the most accurate estimate of body fatness (Wells et al. 2002). Many studies in children have shown that BMI has a significant association with both FM and %FM (Hannan et al. 1995, Goran et al. 1996, Deurenberg et al. 1998, Pietrobelli et al. 1998) but comparatively weaker with the latter. The varying associations that are seen among children could be due to the changes that occur in FM and FMI with age in each sex. FM and FFM in children change rapidly with age in either sex and this leads to a change in BMI with age that affects the relationship between BMI and FM and BMI and %FM from infancy through childhood to adolescents. However, the simplicity and reproducibility of BMI has made it the most popular diagnostic tool for obesity. Malina and Katzmarzyk (1999) showed that although BMI had a very high specificity, the sensitivity was very low, quite similar to the results of our study. CDC/NCHS and BMI-*Z* scores had an improved sensitivity over IOTF as the references were derived from normal populations, and it was detecting a proportion of 'normal' children in the community, where as IOTF cut-offs were derived based on an arbitrarily set BMI cut-off value of 30 $kg\,m^{-2}$ at 18 years and calculating an equivalent BMI at ages 0–18 years, matching the physiological BMI change that occur with age in each sex. It is clear that BMI cannot give an accurate value or estimate to an individual's %FM, which is the morbid factor of obesity. This is to be expected, as BMI is an index of measure of body size and not body composition and its drawbacks as an indicator of obesity, i.e. assessing %FM, have been highlighted (Garn et al. 1986). A high BMI could be made up either by excess adipose tissue or by muscle hypertrophy, and the converse is also true. However, Garrow and Webster (1985) showed that BMI and FMI had a strong association. Davies et al. (2001) showed that BMI had a stronger association with FMI than with %FM. Data in this study showed a strong association between BMI and FM – greater than any other associations that we looked for. Once a strong relationship is established, a prediction equation could be derived to calculate FM and hence %FM. However, in this study we did not intend to derive a regression equation to estimate the FM using BMI because the sample we studied was not large enough and it also did not have a separate group of subjects to cross-validate the derived prediction equations. Furthermore, we have not studied the body composition of children of other ethnic origins. It is important that studies of the body composition of Australian children of all ethnic origins are carried out before determining a prediction equation that could be used on children across all ethnic backgrounds living in this multi-cultural society.

Another important fact expressed by this study is that in these two groups studied, the ethnic origin did not influence the association between BMI and %FM, and BMI-*Z* and %FM. This gives rise to the question of whether the socio-economic environment influences the body compositions more than ethnicity. The fact that the American white Caucasians have a lower %FM compared with their European counterparts (UK and The Netherlands) at the same BMI level (Deurenberg 1998) has given some weight to the notion that socio-economic environment influences body composition. However, this fact needs further investigation.

This study showed that the sensitivity and efficiency of present BMI cut-offs are low, not only among the children of Sri Lankan origin but also among the second- or third-generation Australian white Caucasians. Therefore it would be prudent to say that BMI should be used to screen for obesity rather than diagnose, and cut-off values should be revised to suit a population rather than different ethnic groups within a population. More definitive diagnostic tools should be used to determine percentage body fat mass and hence diagnose obesity.

Summary

BMI and %FM did not have an association that would be clinically useful in the group of children studied. The present BMI-based cut-off values did not show adequate sensitivity in screening and diagnosing childhood obesity. The ethnic origin of these children has not influenced the association between BMI and %FM. Focus needs to be directed towards the diagnosis of obesity based on %FM and, to improve diagnosis, either BMI based cut-off values should be revised to suit populations or alternative methods of measuring/estimating %FM should be explored.

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Résumé. *Arrière plan:* Bien que l'indice de masse corporelle (IMC) soit utilise pour porter un diagnostic d'obésité, sa capacité prédictive du pourcentage de masse grasse (%MG) est médiocre. Sa validité en tant qu'outil de diagnostic de l'obésité est par conséquent mise en question.
But: Cette étude a pour objet de déterminer l'aptitude des valeurs charnières fondées sur l'IMC pour diagnostiquer l'obésité chez des enfants australiens blancs, d'origine caucasienne et sri lankaise.
Sujets et méthodes: On a mesuré le poids et la stature et calculé l'IMC (P/Ṡ) ; L'eau corporelle totale a été déterminée par la technique de dilution du deutérium et la masse maigre et par suite la masse grasse, extrapolées au moyen de constantes spécifiques de l'âge et du sexe. Le critère du seuil de l'obésité a été considéré être de 30% de MG pour les filles et de 20% pour les garçons. Les limites de l'obésité décrites par l'International Obesity Task Force (IOTF) à partir de l'IMC, les graphiques de percentiles CDC/NCHS et les IMC-Z ont été validés en comparaison de la méthode des critères.
Résultats: Il y avait 96 caucasiens blancs et 42 enfants sri lankais. 19 des filles blanches caucasiennes (36%) et 29 (66%) des garçons ainsi que 7 (46%) des sri lankaises et 16 (63%) des garçons étaient obèses, sur la base du % MG. La MG et l'IMC sont étroitement associés aussi bien chez les caucasiens ($r = 0.81$, $P < 0.001$) que chez les sri lankais ($r = 0.92$, $P < 0.001$). Le % MG et l'IMC présentent également une association, plus faible mais significative. Les valeurs limites de l'obésité recommandées par l'IOTF ont échoué dans la détermination de l'obésité d'un seul cas dans chaque groupe. Cependant, les limites NCHS et IMC-Z ont détecté des cas d'obésité avec une sensibilité basse.
Conclusions: L'IMC est un mauvais indicateur du pourcentage de graisse et les valeurs limites communément utilisées ne se sont pas révélées suffisamment sensibles pour détecter les cas d'obésité des enfants de cette étude. Afin d'améliorer le diagnostic d'obésité, soit les valeurs limites d'IMC devraient être revues pour accroître la sensibilité, ou bien la possibilité d'utiliser d'autres méthodes indirectes d'estimation du %MG devrait être explorée.

Zusammenfassung. *Hintergrund:* Der Körpermasse-Index (body mass index, BMI) wird verwendet, um Adipositas zu definieren. Allerdings ist zweifelhaft, in welchem Maße er den prozentualen Anteil der Fettmasse (%FM) zuverlässig vorhersagen kann. Aus diesem Grunde wird die Wertigkeit des BMI als diagnostisches Hilfsmittel bei Adipositas in Frage gestellt.
Ziel: Ziel der Studie ist, die Bedeutung von BMI-basierten Grenzwerten beim Erkennen von Adipositas bei Australischen Kindern kaukasischer und Sri Lankischer Herkunft zu bestimmen.
Probanden und Methoden: Es wurden Körperhöhe und Gewicht gemessen und BMI (Gewicht/Körperhöhė) berechnet. Die Bestimmung von Ganzkörperwasser erfolgte mit der Deuterium-Verdünnungsmethode, und die Bestimmung von fettfreier Körpermasse und entsprechend von Körperfettmasse mit alters- und geschlechtsspezifischen Konstanten. Ein %FM von 30% bei Mädchen und von 20% bei Knaben wurde als kritischer Grenzwert für Adipositas angesehen. Die von der International Obesity Task Force (IOTF), die über

CDC/NCHS Perzentilkurven und die über BMI Z-Werte definierten BMI-basierten Grenzwerte wurden gegen die genannten kritischen Grenzwerte validiert.
Ergebnisse: Es wurden 96 hellhäutige kaukasische und 42 Kinder Sri Lankischer Herkunft untersucht. Von den hellhäutigen kaukasischen Kindern waren 19 (36%) Mädchen und 29 (66%) Knaben, von den Sri Lankischen Kindern 7 (46%) Mädchen und 16 (63%) Knaben adipös, wenn über %FM definiert. FM und BMI waren sowohl bei kaukasischen ($r = 0.81$, $P < 0.001$) als auch bei Sri Lankischen Kindern ($r = 0.92$, $P < 0.001$) hoch korreliert. Prozentualer Anteil der Fettmasse und BMI korrelierten ebenfalls signifikant, aber niedriger. Die von der IOTF empfohlenen Grenzwerte erwiesen sich als ungeeignet, um Einzelfälle von Adipositas in den jeweiligen Gruppen zu erkennen. Allerdings ließen sich adipöse Kinder mit niedriger Sensitivität über NCHS- und BMI Z-Wert-definierte Grenzwerte erkennen.
Zusammenfassung: BMI ist ein schlechter Indikator für den prozentualen Anteil der Fettmasse, und die üblicherweise genutzten Grenzwerte waren in dieser Studie nicht sensitiv genug, um Einzelfälle von Adipositas bei Kindern zu erkennen. Um das Erkennen von Adipositas zu verbessern, sollten zur Anhebung der Sensitivität entweder die BMI-basierten Grenzwerte revidiert oder möglicherweise andere indirekte Methoden exploriert werden, den %FM zu schätzen.

Resumen. *Antecedentes:* El índice de masa corporal (IMC) se utiliza para diagnosticar la obesidad. Sin embargo, su capacidad para predecir de forma fiable el porcentaje de masa grasa (%MG) es dudosa. Por lo tanto, se cuestiona la validez del IMC como herramienta de diagnóstico de la obesidad.
Objetivo: Este estudio se centra en determinar la capacidad de los valores de corte basados en el IMC para el diagnóstico de la obesidad, entre niños australianos de orígenes caucásico blanco y de Sri Lanka.
Sujetos y métodos: Se midieron la estatura y el peso y se calculó el IMC (peso/estatura^2). La cantidad total de agua se determinó mediante la técnica de dilución con deuterio y se derivaron la masa libre de grasa y a partir de ésta la masa grasa, utilizando constantes específica para cada edad y sexo. Como criterio para los puntos de corte de la obesidad se consideraron un %MG del 30% en chicas y del 20% en chicos. El IMC basado en los puntos de corte para la obesidad descritos por la International Obesity Task Force (IOTF), las curvas centilares del CDC/NCHS y el IMC-Z, fue validado frente al criterio elegido.
Resultados: Había 96 niños caucásicos blancos y 42 de Sri Lanka. De los caucásicos blancos, 19 niñas (el 36%) y 26 niños (66%), y de los de Sri Lanka, 7 niñas (46%) y 16 niños (63), eran obesos según el %MG. La MG y el IMC estaban estrechamente asociados, tanto en los caucásicos ($r = 0.81$, $P < 0.001$) como en los de Sri Lanka ($r = 0.92$, $P < 0.001$). El porcentaje de MG y el IMC también tenían una baja aunque significativa asociación. Los valores de los puntos de corte recomendados por el IOTF no conseguían detectar un simple caso de obesidad en cada grupo. Sin embargo, los puntos de corte del NCHS y el IMC-Z detectaban casos de obesidad con baja sensibilidad.
Conclusiones: El IMC es un pobre indicador del porcentaje de grasa y los valores de corte habitualmente utilizados no fueron lo suficientemente sensibles como para detectar casos de obesidad infantil en este estudio. Para mejorar el diagnóstico de la obesidad, deberían revisarse tanto los puntos de corte del IMC con el objeto de incrementar la sensibilidad, como explorar la posibilidad de utilizar otros métodos indirectos de estimación del %MG.