Identifying very fat and very thin children: test of criterion standards for screening test

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Charts of body mass index (weight (kg)/(height $(m)^2$)) for children have been recommended for clinical use in the United Kingdom.[1] It is unclear how they are to be used, but the accompanying referral guidelines suggest that they have a place in community screening. Caution has been urged, however, when using body mass index for children of different heights.[2] Data from the Wessex growth study show that 10% of short normal children—compared with 27% of controls—had a body mass index ≥75th centile at the age of 9 years (unpublished data). To determine the reason for this apparent bias, we examined the weight for height relations required for prepubertal children of different heights to have a high or low body mass index.

Methods and results

Weights and weight standard deviation scores were calculated for children of different heights to give body mass indices ≥99.6th centile and ≤0.4th centiles. The difference between height and weight centiles was then calculated. The table shows data for boys aged 2-9 years with heights on the 99.6th, 50th and 0.4th centiles. Results for girls were similar.

To have a body mass index on the 99.6th centile the discrepancy between weight and height for a child of average height is around three centile bands, regardless of age. For children of other heights, however, the discrepancy varies with height and age. For example, the discrepancy for a tall child ranges from 1.67 centiles at age 2 years to less than half a band at 9, while short children require weight to be at least four centiles above height to have the same body mass index score. To have a body mass index ≤0.4th centile, however, the discrepancy between weight and height for a child of average height is less than three centiles, while tall and short children require larger or smaller discrepancies (table).

Comment

Body mass index is well established as a measure of relative fatness in adults, but during childhood it changes substantially with age and must be assessed using age related curves such as those provided on the charts. Body mass index, however, correlates with height,[3] short children having lower body mass indices, and thus lower body mass index standard deviation scores, than tall ones. Using body mass index to assess weight for height in the community may identify a disproportionate number of tall, apparently overweight, children, while short overweight children will be harder to detect.

Other methods of identifying weight disorders have been proposed—for example, a discrepancy between weight and height of more than three centiles.[3] Although there is a general acceptance that healthy children have similar height and weight centiles, our data show that overweight and underweight children cannot be identified by the same criterion. To have a body mass index ≥99.6th centile, the discrepancy between weight and height for a child of average height is three centiles, but to have a body mass index ≤0.4th centile, the discrepancy is less than three centiles. Furthermore, except for those of average height, the relation between height, weight, and body mass index varies considerably throughout childhood.

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Relation between height and weight in tall, average, and short prepubertal boys for a body mass index (wt/ht^2) equal to the 99.6th centile and the 0.4th centile)

	Tall (99.6th centile)				Average (50th centile)				Short (0.4th centile)			
Age (years)	Height (cm)	Weight (kg)	Weight (SD score)	Discrepancy between weight and height (centile bands)*	Height (cm)	Weight (kg)	Weight (SD score)	Discrepancy between weight and height (centile bands)*	Height (cm)	Weight (kg)	Weight (SD score)	Discrepancy between weight and height (centile bands)*
Obese boys (body mass index=99.6th centile)												
2	95.6	18.7	3.78	1.67	87.1	15.6	2.17	3.23	78.6	12.7	0.25	4.36
3	105.8	22.1	3.63	1.43	95.8	18.1	1.99	2.98	85.8	14.6	0.19	4.13
4	114.2	25.5	3.46	1.19	103.0	20.8	1.95	2.90	91.9	16.5	0.02	4.01
5	121.8	29.4	3.34	1.00	109.7	23.9	1.95	2.91	97.5	18.9	0.14	4.19
6	128.8	33.9	3.26	0.89	115.8	27.4	2.00	2.99	102.8	21.6	0.34	4.48
7	135.6	39.2	3.15	0.72	121.8	31.6	2.06	3.07	108.0	24.9	0.58	4.84
8	142.4	45.6	3.01	0.51	127.7	36.7	2.08	3.11	113.1	28.8	0.78	5.14
9	148.7	52.6	2.89	0.34	133.2	42.2	2.08	3.10	117.7	33.0	0.91	5.34
Underweight boys (body mass index=0.4th centile)												
2	95.6	12.6	0.18	−3.71	87.1	10.4	−1.69	−2.52	78.6	8.5	−3.74	−1.61
3	105.8	14.9	0.29	−3.55	95.8	12.2	−1.60	−2.39	85.8	9.8	−3.84	−1.75
4	114.2	17.1	0.33	−3.48	103.0	13.9	−1.56	−2.32	91.9	11.1	−3.85	−1.76
5	121.8	19.3	0.32	−3.51	109.7	15.6	−1.55	−2.31	97.5	12.3	−3.95	−1.91
6	128.8	21.3	0.23	−3.64	115.8	17.2	−1.57	−2.34	102.8	13.6	−3.90	−1.85
7	135.6	23.4	0.14	−3.77	121.8	18.9	−1.57	−2.35	108.0	14.8	−3.97	−1.95
8	142.4	25.7	0.04	−3.91	127.7	20.7	−1.61	−2.40	113.1	16.2	−3.97	−1.94
9	148.7	28.2	−0.02	−4.01	133.2	22.7	−1.60	−2.38	117.7	17.7	−3.93	−1.89

*Calculated by subtracting height standard deviation score from weight standard deviation score and dividing by 0.67.

There is as yet no agreed measure of obesity in children.[1] The prevalence of obesity increases with age, and the centiles defining adult obesity are unlikely to yield a similar proportion of clinically obese children. Furthermore, targeting obese children is unlikely to identify those most at risk of becoming obese adults.[4] Visceral fat distribution is likely to prove a better predictor of subsequent morbidity than absolute fat mass.[5] The charts allow change in body mass index to be observed in an individual child, but this may be no more valuable than the longitudinal monitoring of height and weight from which body mass index is derived. Children with diverging height and weight centiles should perhaps be referred rather than waiting for body mass index to cross an arbitrary cut off point, especially one that has no proved clinical correlate.

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Maternal mortality in the former East Germany before and after reunification: changes in risk by marital status

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Maternal mortality is a sensitive indicator of social inequalities and is closely linked to socioeconomic and marital status. In the former West Germany the risk of maternal death is 1.8 times higher in unmarried women than in married women,[1] and being unmarried is closely associated with lower socioeconomic status.[2]

German reunification, which took place in 1990, was accompanied by major social and societal changes in the former East Germany. Overall fertility declined by 60% between 1989 and 1994, but the proportion of births to unmarried women rose progressively from 23% in 1980 to 42% in 1996. We examined the impact of marital status on maternal mortality in the period before and the period after German reunification in the area covered by the former East Germany (referred to in this article as eastern Germany).

Methods and results

We calculated the maternal mortality ratio by relating the number of maternal deaths (codes 630-676 according to the international classification of diseases, ninth revision) among women resident in eastern Germany in 1980-96 to the respective number of live births, using national register data. We investigated the effect of marital status, controlling for maternal age and year of death, in a Poisson regression model.

Altogether, 413 maternal deaths and 2.99 million live births were reported (table). The overall maternal mortality ratio was stable before, and declined after, reunification. Before reunification, unmarried women had a risk of maternal death equal to that of married women (table); after reunification, they had 2.6 times the age adjusted risk of married women. Unmarried status thus became a significant risk factor for maternal mortality in eastern Germany after reunification.

Comment

Maternal death registration in the former East Germany required panel review and compulsory postmortem examination and was regarded as nearly complete.[3] At reunification, the more relaxed reporting system of the former West Germany was adopted. As no evidence exists of major differences in accessibility or quality of obstetric care in the former East Germany

Demographic data and relative risk of maternal death by marital status, eastern Germany

Variable	Before reunification, 1980-90	After reunification, 1991-6
Demography:		
Total No of live births (No and proportion of unmarried women)	2 453 627 (767 619; 31.3%)	532 394 (222 126; 41.7%)
Total No of maternal deaths (No and proportion of cases of unmarried women)	368 (102; 27.7%)	45 (26; 57.8%)
Overall crude maternal mortality ratio per 100 000 live births (95% CI)	15 (13.5 to 16.6)	8.5 (6.3 to 11.3)
Modelling:		
Crude relative risk of unmarried *v* married women (95% CI)	0.84 (0.67 to 1.06)	1.91 (1.06 to 3.45)†
Age adjusted relative risk of unmarried *v* married women (95% CI)	1.08 (0.85 to 1.36)	2.56 (1.41 to 4.63)‡

CI=confidence interval.
†P=0.01 in the χ^2 test for unequal rate ratios.
‡P=0.01 in the likelihood ratio test for interaction between marital status and time period of death.