

## SHORT COMMUNICATION

# Secular changes of anthropometric measures for the past 30 years in South-West Germany

G Nagel<sup>1</sup>, M Wabitsch<sup>2</sup>, C Galm<sup>3</sup>, S Berg<sup>2,3</sup>, S Brandstetter<sup>4</sup>, M Fritz<sup>5</sup>, J Klenk<sup>1</sup>, R Peter<sup>1</sup>, D Prokopchuk<sup>4</sup>, R Steiner<sup>4</sup>, S Stroth<sup>5</sup>, O Wartha<sup>5</sup>, SK Weiland<sup>1,\*</sup> and J Steinacker<sup>4</sup>

<sup>1</sup>Institute of Epidemiology, Ulm University, Ulm, Germany; <sup>2</sup>Division of Paediatric Endocrinology and Diabetes, Department of Paediatrics, Ulm University Medical Centre, Ulm, Germany; <sup>3</sup>Division of Paediatric Cardiology, Department of Paediatrics, Ulm University Medical Centre, Ulm, Germany; <sup>4</sup>Division of Sports and Rehabilitation, Department of Internal Medicine II–Cardiology, Ulm University Medical Center, Ulm, Germany and <sup>5</sup>Transfercenter for Neuroscience and Learning (ZNL), University of Ulm, Ulm, Germany

We investigated long-term changes in weight and skinfold thicknesses in German schoolchildren. In 2006, anthropometric measures were collected after a standardized protocol among 1079 children within the Ulm Research on Metabolism, Exercise and Lifestyle in children (URMEL-ICE) study. Data were compared with historical data (1975–1976). In URMEL-ICE, prevalence of overweight (IOTF criteria) was 16.5% (boys) and 17.3% (girls) and of obesity 3.5 and 3.6%, respectively. Compared with historical data the number of children above the 90th percentile<sub>1975/76</sub> increased statistically significantly for weight (approximately 150% both sexes), for subscapular (boys 288%, girls 206%) and triceps skinfold thickness (boys 460%, girls 413%). Statistically significant increases above the 50th percentile<sub>1975/76</sub> were found: weight 36 and 26%, subscapular 43 and 60% and triceps skinfold thickness 63 and 69% for boys and girls, respectively. Body fat among 6- to 9-year-old children increased dramatically within 30 years. Moreover, our data suggest substantial changes in body composition among normal-weight children towards an increased body fat mass.

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### Introduction

The prevalence of childhood obesity has increased during the past decades in many countries (Ebbeling *et al.*, 2002). Body mass index is routinely measured, but it is an imperfect tool. However body mass index is highly correlated with body fat mass and also with fat-free mass. In children, the appraisal of fat components indicated by skinfold thickness is complicated by differences in growth rates and maturity levels.

As the changes in body composition could have extensive health implications, we analyzed weight status and skinfold thickness in schoolchildren measured 30 years apart.

### Materials and methods

As part of the Ulm Research on Metabolism, Exercise and Lifestyle in children (URMEL-ICE) study a baseline cross-sectional assessment was carried out in 2006.

Out of 5044 eligible children in 123 primary schools in the Ulm region, 32 schools with 1427 pupils aged 6–9 years agreed to participate. The study was approved by the ethical committee of the Ulm University. Of those, 1079 (96%) children (mean age 7.6 years (s.d. 0.4)) agreed to participate in a physical examination. The height of children, wearing only underclothes, was measured to 0.1 cm (Ulm stadiometer, Busse Design, Ulm, Germany) and weight to 0.1 kg on a calibrated balance beam scale (Seca, Hamburg, Germany). Skinfold thicknesses (triceps, subscapular) were measured with Lange skinfold caliper (Santa Cruz, CA, USA). Overweight and obesity were classified according to IOTF reference values (Cole *et al.*, 2000). All anthropometric measurements were determined three times in standardized manner by trained personnel at Ulm Children's Hospital.

Correspondence: Professor Dr M Wabitsch, Division of Paediatric Endocrinology and Diabetes, Department of Paediatrics and Adolescent Medicine, Ulm University, Eythstr. 24, Ulm 89075, Germany.  
E-mail: martin.wabitsch@uniklinik-ulm.de

\*Deceased.

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A cross-sectional study among 3418 girls and 3430 boys aged 4–16 years was carried out between 1975 and 1976 in the Ulm region (Engelhardt, 1977). All anthropometric measurements were carried out by personnel of the Ulm Children's Hospital in standardized manner (Engelhardt, 1977). The height of children, wearing only underclothes, was measured to 0.5 cm and weight to 0.1 kg on a calibrated mechanical balance. Skinfold thickness measurements (triceps, subscapular) were determined using a skinfold caliper (Holtain Ltd, Crymych, UK).

Historical data are solely available on an aggregated level stratified by 3 months of age at an average of 69 girls and 70 boys per stratum (Engelhardt, 1977).

For the comparison with URMEL-ICE, data of children aged 6–9 years were selected from the Ulm Children Study 1975–6 and the relative change in the age-specific 10th, 50th and 90th percentiles of the anthropometric measures was calculated by sex. One sample z-test was applied to test for differences in proportions. Two-sided *P*-values <0.05 were considered statistically significant. All analyses were carried out using SAS 9.1 (SAS Institute, Cary, NC, USA).

## Results

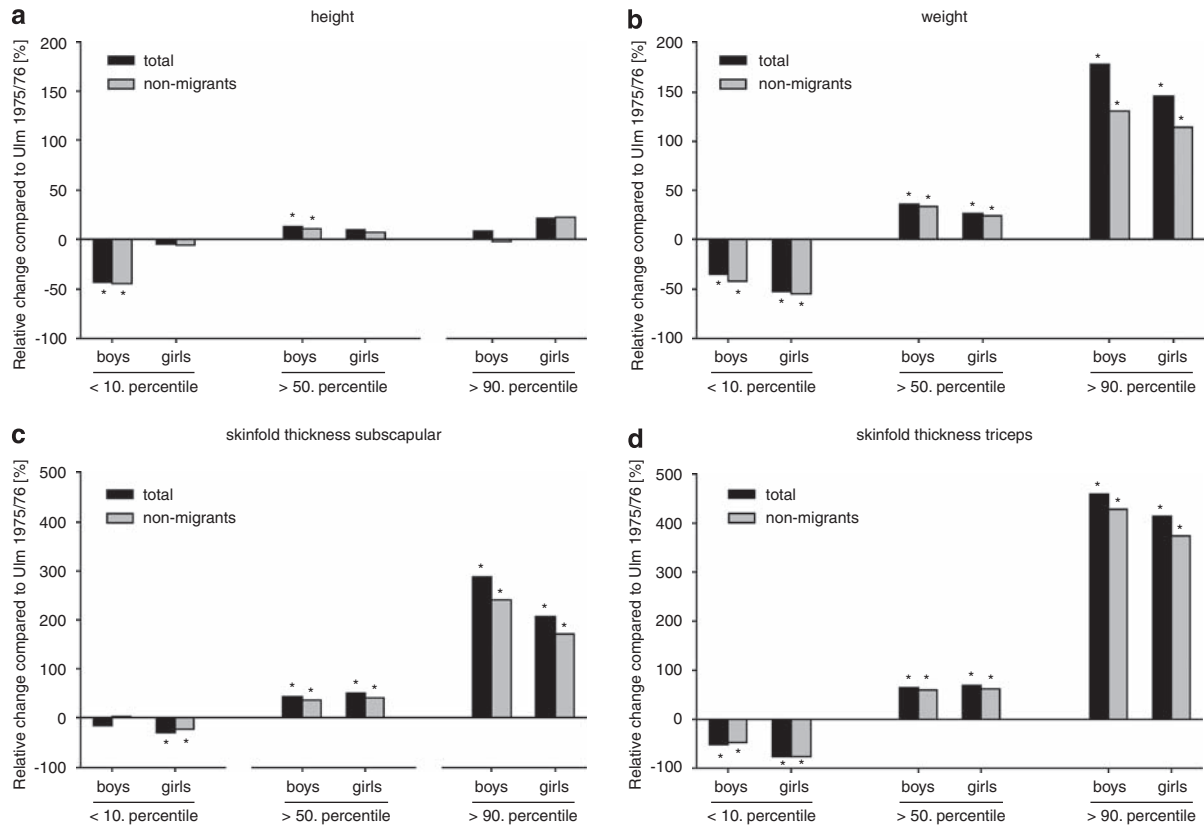
Table 1 shows the sample characteristics by sex. In both assessments mean skinfold thickness for subscapular

and triceps measurements were on an average higher among girls than boys. Children did not change in height, but gained weight over the past 30 years. Skinfold thickness (triceps and subscapular) increased between both assessments. The prevalence of overweight in URMEL-ICE was 16.5% in boys and 17.3% in girls and of obesity 3.5 and 3.6%, respectively.

Figures 1a–d present the relative changes (%) of sex-specific anthropometric measures between URMEL-ICE and Ulm Children Study 1975–6. Compared with historical data, fewer boys (–35%) and girls (–53%) in 2006 were classified below the 10th percentile<sub>1975–6</sub> for weight, whereas classification above the 90th percentile<sub>1975–6</sub> increased by 178% in boys and 146% in girls. Height did not differ substantially between both surveys, except that fewer boys (–43%) were classified to the 10th percentile<sub>1975–6</sub>. With regard to subscapular skinfold thickness, the assignment to above the 90th percentile<sub>1975–6</sub> statistically significantly increased by 288% in boys and by 206% in girls. There were substantially more children above the 90th percentile<sub>1975–6</sub> of triceps skinfold thickness in both sexes (+460% in boys and +413% in girls). Compared with the 50th percentile<sub>1975–6</sub>, statistically significant increases were observed for body weight in both boys (36%) and girls (26%), for subscapular skinfold thickness in both boys (43%) and girls (60%) and also for triceps skinfold thickness in both boys (63%) and girls (69%).

**Table 1** Anthropometric measures in the Ulm children study (1975–6) and the URMEL-ICE (2006) by age and sex

	<i>Ulm children study (1975–6)</i>						<i>URMEL-ICE (2006)</i>					
	Boys			Girls			Boys			Girls		
	10th	50th	90th	10th	50th	90th	10th	50th	90th	10th	50th	90th
<i>Height (cm)</i>												
6.5 years	114.0	120.5	127.5	114.0	120.0	126.0	109.9	122.9	126.9	116.4	121.9	130.3
7.0 years	116.5	123.5	130.5	116.0	123.0	129.0	118.9	126.1	131.8	117.4	123.9	130.5
7.5 years	119.0	126.5	133.0	118.5	125.5	132.5	120.7	127.4	133.6	119.7	126.5	133.3
8.0 years	122.0	129.5	136.0	121.5	128.5	135.5	123.0	129.6	136.1	120.8	128.4	134.9
8.5 years	124.5	132.0	139.0	124.0	131.5	139.0	124.5	132.2	137.3	123.1	127.6	133.8
<i>Weight (kg)</i>												
6.5 years	18.5	21.7	25.6	18.0	21.3	24.7	15.4	22.5	23.4	18.6	23.0	27.5
7.0 years	19.5	22.9	26.9	18.8	22.3	26.3	20.9	25.1	31.7	20.3	23.8	30.9
7.5 years	20.5	24.1	28.2	19.6	23.4	28.1	21.8	25.5	34.0	20.0	24.5	33.7
8.0 years	21.6	25.5	29.7	20.5	24.6	30.0	22.4	27.0	34.2	21.1	25.8	34.6
8.5 years	22.7	26.9	31.3	21.5	26.0	32.2	22.1	29.5	36.9	22.8	26.0	33.3
<i>Triceps skinfold thickness (mm)</i>												
6.5 years	6.1	8.0	10.6	6.8	9.3	12.5	5.7	8.2	12.0	8.0	13.5	16.3
7.0 years	6.0	8.0	10.9	6.9	9.5	13.0	7.7	12.0	20.7	8.7	13.2	23.0
7.5 years	6.1	8.1	11.3	7.0	9.7	13.6	7.0	12.0	22.0	9.3	13.7	25.3
8.0 years	6.1	8.3	11.8	7.2	10.0	14.1	7.2	12.0	22.0	8.3	14.3	25.3
8.5 years	6.2	8.5	12.4	7.3	10.2	14.7	8.2	13.7	24.8	12.0	15.5	23.0
<i>Subscapular skinfold thickness (mm)</i>												
6.5 years	4.0	4.9	6.4	4.2	5.5	7.7	4.0	4.5	6.3	4.7	6.0	9.7
7.0 years	4.0	5.0	6.7	4.3	5.6	8.2	4.3	6.7	11.7	5.0	7.0	15.7
7.5 years	4.1	5.1	7.0	4.4	5.8	8.7	4.3	6.0	13.3	5.0	7.0	15.3
8.0 years	4.2	5.3	7.5	4.6	6.0	9.4	4.3	6.7	11.3	4.3	7.3	14.7
8.5 years	4.2	5.4	8.0	4.7	6.2	10.0	4.3	6.7	13.3	5.3	7.5	15.0



**Figure 1 (a–d)** Relative change (%) in the URMEL-ICE study (2006) of numbers of children with height, weight, subscapular and triceps skinfold thickness exceeding the age-specific 10th, 50th and 90th percentiles of the Ulm Children Study (1975–6); \* $P < 0.05$ .

## Discussion

In the URMEL-ICE study, the overall prevalence rates of overweight and obesity were higher than previous data from Germany that also used the IOTF definitions among 6- to 7-year-old children (Kuepper-Nybelen *et al.*, 2005), and were also higher than recent results from the German Health Interview and Examination Survey for Children and Adolescents (KIGGS) conducted among children aged 7–10 years when using German reference data (Kurth and Schaffrath, 2007).

Our observation of higher values for both triceps and subscapular skinfold thickness in girls than in boys are in line with others (Stolzenberg *et al.*, 2007). Increased skinfold thickness became particularly apparent in normal-weight children. It can be speculated that over time, notably, body mass has changed mainly due to a change in fat mass, indicating changes in physical activity.

In consistency with published data, we found no major change for height (Herpertz-Dahlmann *et al.*, 2003). Numbers of children with body weight above the 90th percentile<sub>1975–6</sub> increased substantially, whereas that below the 10th percentile decreased only moderately. This observation support findings of other reports focusing on body mass

index (Kalies *et al.*, 2002; Herpertz-Dahlmann *et al.*, 2003; Kromeyer-Hauschild and Zellner, 2007; Meigen *et al.*, 2008). Dietary changes with increased consumption of energy-dense foods were associated with obesity (Ebbeling *et al.*, 2002).

Migration background is associated with overweight and obesity (Kuepper-Nybelen *et al.*, 2005). With regard to historical data, no information on migration background was available. The exclusion of children with migration background (29.7%) in the URMEL-ICE data resulted in slightly attenuated relative changes.

Measurement errors of the skinfold thickness may be of concern. However, all data were collected in a standardized manner in the same region and by trained staff. Our historical data were in good agreement with the data on height and weight from Germany in 1975–6 (Herpertz-Dahlmann *et al.*, 2003). However, selection bias due to different response behaviour could not completely be ruled out.

In conclusion, we observed increasing prevalence of overweight and obesity in 6- to 9-year-old children in Germany over the past 30 years. The comparison with historical data revealed an increase in excess weight and indicated dramatic trends in body composition also in normal-weight children.

## Conflict of interest

The authors declare no conflict of interest.

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