Growth of general body size of children in a fishing village in Indonesia

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Abstract  The aim of this paper is to describe the characteristics of growth in children of a fishing village in Indonesia, and to compare these with those of children in a city and in an agricultural village. The height, weight, and body mass index (BMI) of children (254 boys and 286 girls) aged 7–18 years in a fishing village in Sumatra were investigated, and the biological variables based on cross-sectional data were obtained by cubic spline analysis. The children are smaller and lighter than city children. In the fishing and agricultural villages, where an equivalent social status was observed, a similarity in growth patterns was exhibited. In the fishing village, the girls’ age at ‘peak,’ i.e. maximum yearly increment, height and weight occurred about 1 year earlier than that of the boys. Height and weight at ‘peak’ were 4.5 cm taller and 1.2 kg heavier in the boys than in girls. The girls exhibited greater BMI, as well as weight, than the boys after age 10. The BMI was greater in the girls than in the boys except at ages 7 and 9, and the three variables affecting the ‘peak’ (i.e. increment, age, and value at peak) were identical in both sexes. In conclusion, the children belonging to the same socioeconomic status, whether living in a fishing village or an agricultural village, showed a similar process of growth, and a comparison with children living in a city suggested the main factor affecting growth is the improvement in the socioeconomic conditions in Indonesia.

Key words: height, weight, BMI, children, fishing village

Environmental influences on children living in, e.g. fishing, urban, and agricultural areas, during their growth and sexual maturation, have become a focus of interest. Based on experimental investigations, Tanner (1989) suggested that children in urban areas are usually larger and have a more rapid rate of growth than children in villages.

Several studies in human biology, especially in auxology, have investigated the variation in growth, focussing on anthropometric traits in different social strata, or in rural and urban peoples, and in developed and developing countries (Ashizawa et al., 1998; Zverev and Gondwe, 2001; Hakeem et al., 2004; Rahmawati et al., 2004; Eiben et al., 2005; Foster et al., 2005; Medhi et al., 2006; Nwokoro et al., 2006). This study describes growth in height, weight, and body mass index (BMI) of children in a fishing village, and compares these metrics with those of children in urban and agricultural areas from the same country.

Subjects and Methods

The present cross-sectional data are based on a sample of schoolchildren, from a fishing village in Padang, investigated in 2006, and cover 357 boys and 478 girls, aged 7–18 years old. Ethnically these children are Minang. Padang is the capital of West Sumatra, located at 0°57’S and 100°21’E. The surface area of the city of Padang is 694.96 km². The village is one of the sub-districts of Padang, where a major earthquake and resulting tsunami occurred in 2004, one and
a half years before this study was carried out. All of the children of this group were born and lived in this village. The majority of their fathers were fishermen (55.6%), farmers (9.3%), employees (15.4%), and others (19.7%). The children’s mothers were housekeepers (96.8%), civil servants (2.3%), and others (0.9%).

For comparison we used two groups of children aged 7–15 years old from an urban area of Yogyakarta (340 boys and 371 girls) and an agricultural village of Bantul (222 boys and 243 girls), measured in 1999 and 2001, respectively, in Java (Rahmawati et al., 2004).

All of the subject children were physically and mentally normal and did not suffer from any apparent illness at the time of examination. The date of birth of each child was recorded not only from school registers but also verified from the children at the time of investigation. The data so collected were grouped into nine decimal age groups of one-year intervals according to a standard international method (Weiner and Lourie, 1981; ISO 15535, 2003): ‘age 10,’ for example, was composed of children aged 9.50–10.45.

Specially designed questionnaires were used to elicit information from participating subjects about their age, sex, birth date, medical history, and parents’ occupation. Height (cm) and weight (kg) were measured in the morning as far as possible, and BMI was calculated for each child (BMI = weight (kg)/height (m)²). As all of the children came from Islamic families, they could not be examined wearing ‘minimum clothing’ during the examination; the girls in particular had to keep the traditional scarf and long skirt. Therefore, we measured the weight of their clothing, and subtracted this weight from the body weight for each child, i.e. 400 g for the elementary school boys and girls, 450 g for the high school boys, and 500 g for the high school girls. The weight presented in Table 1 reflects the results of subtraction.

Children deviating by more than ±3SD from the group mean of their age and sex were excluded. The results given in Table 1 and Table 2 were obtained from this final data set without the outlier subjects.

The distribution pattern was examined for the three measurement items in each age group and sex in the respective area. When more than two-thirds of the age groups for a given measurement of a given sex were determined as normal, the distribution pattern of this measurement as a whole was considered as normal. As a result, all measurements presented a normal distribution in both sexes. Therefore Tukey’s highest significant difference multiple comparison was used to examine the difference among three areas, and the t-test was used for the sex difference within an area. A cubic spline analysis package (Spline Smoothing Analysis, version 2, Nippon IMSL Co. Ltd., Japan) was used in this cross-sectional study to obtain the yearly increment of height, weight, and BMI.

Results

Mean and SD values of height, weight, and BMI of the subject children are presented in Table 1. The biological variables obtained from the cubic spline analysis of the mean yearly increment curves based upon the cross-sectional data are presented in Table 2. Figure 1 shows the growth curves of means in each measurement of the subject children. Comparisons with the Yogyakarta and Bantul children are presented in Figure 2 and Figure 3, respectively.

Table 1. Mean values and standard deviations (SD) of height, weight, and body mass index (BMI) of the children in fishing village, Indonesia

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<th>Areas</th>
<th>Age</th>
<th>N</th>
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<th>Height (cm) Mean</th>
<th>Height (cm) SD</th>
<th>Weight (kg) Mean</th>
<th>Weight (kg) SD</th>
<th>BMI Mean</th>
<th>BMI SD</th>
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We observe in Table 2 that the girls’ age at ‘peak’ of height and weight occurred about 1 year ahead of the boys’ age at ‘peak’ except the children in Yogyakarta. In the fishing village the boys’ weight at ‘peak’ was 1.2 kg heavier than that of the girls, and in the agricultural village the boys’ weight was 4.9 kg heavier than that of the girls. In the fishing village, not only for the maximum yearly increment, but also for age and BMI at maximum increment, the girls’ BMI at ‘peak’ was similar to that of the boys. Identical yearly increment curves in BMI can be interpreted rationally in terms of the inverse tendency observed in the ages at ‘peak’ between stature and weight.

The Padang children were not smaller than Yogyakarta children at maximum yearly increment in height at ‘peak.’ But the age at ‘peak,’ i.e. the maximum increment, of Padang was 2.7 years (boys) and 1.4 years (girls) behind that of the children of Yogyakarta (Table 2). Weight at ‘peak’ was heavier in the Padang children: by 2.4 kg for the boys and 2.5 kg for the girls. The yearly increment in BMI appearing in the age at ‘peak’ in the Padang children was similar to that found for the Yogyakarta children. Although we cannot give the reason, the BMI of the Padang children at age 15 was slightly greater than that of the Yogyakarta children.

In Table 2, the Padang children were similar to the Bantul children in terms of their age at maximum increment of height; however, the girls in Padang showed a height at maximum increment 4 cm greater than the girls in Bantul. The weight at ‘peak’ of the Padang children was 2.5 kg heavier than that of the Bantul children. The yearly increment in BMI appearing in the age at ‘peak’ in the Padang children was greater than that of the Bantul children, with the age at ‘peak’ 1.8 years in front of the Bantul boys.

**Discussion**

In general, in all human populations, boys are slightly taller than girls until the girls’ adolescent growth spurt begins. Thereafter, girls become taller for the period during which their spurt continues, while the boys’ spurt is yet to occur (Eveleth and Tanner, 1990). Singh (1990) reported that girls from various schools in India were taller than boys at ages 10–12 years and heavier at 10–13 years.

Figure 1 shows the growth curves of the children in Padang. We observe that the boys were significantly taller
than the girls at ages 7 and 15–18, heavier at ages 7, 9, 16, and that the girls’ predominance during puberty was not significant in terms of both height and weight. In contrast, the girls had greater BMI at ages 12–18. The children’s BMI varied from 14.1 at age 7 to 18.8 at age 18 in the boys, and from 13.6 at age 7 to 20.0 at age 18 in the girls. In adults, BMI is considered as a good indicator of obesity, but this is not necessarily true for adolescents because the dramatic increases in BMI in adolescence are due not only to an increase in fat but also to changes in skeletal and muscle components. It is interesting to note in Figure 1 that at ages 15 and 17, the girls in Padang, a fishing village, tended to have significantly greater BMI than the boys. This probably reflects the dramatic increase in BMI after puberty in the girls, whereas, in the boys, the increase is smaller. This phenomenon is similar to the findings with Philippine children.

Figure 2. Comparison of growth and BMI between children in a fishing village and an urban city in Indonesia (*P < 0.05; **P < 0.01).
reported by Ashizawa et al. (1998), suggesting that the ‘toughness’ of girls in conditions of socioeconomic stress manifests itself more in their BMI than in either height or weight. Children and youths today mature at an earlier age than in former times, exhibiting an earlier age at peak with greater height and weight velocities and an earlier age at menarche (Lindgren, 1995).

Comparison of growth of children of Padang, a fishing village, with children of Yogyakarta urban area

The Padang children are smaller and lighter than the Yogyakarta children throughout the growth period, and these differences were great (Figure 2). For height, the difference in the boys of almost all age groups was significant, and the same in the girls except ages 10, 14, and 15. As for weight, the Padang boys were significantly lighter in almost all of age groups except ages 14 and 15, while the girls were significantly lighter at ages 7, 8, 9, and 11 only. In general, the

Figure 3. Comparison of growth and BMI between children in a fishing and an agricultural village in Indonesia (*$P < 0.05$; **$P < 0.01$).
Padang children were smaller and lighter than the Yogyakarta children. As for BMI, however, a significant difference was detected only at ages 8, 10, and 11 in the boys, and at age 9 in the girls.

A possible reason for this greater height and weight of the children in Yogyakarta is that, in developing countries, urban children are usually taller and mature earlier than their rural peers. Bogin (1989) suggested that urban children matured earlier, based on both tooth eruption and age at menarche, than the rural children. Thus, Bogin wrote that even after World War II, the children of urban migrants experienced significant improvements in growth. Moreover, Padang children may have suffered some recent growth delays (caused by the earthquake and tsunami). On the other hand, comparison with Yogyakarta children revealed significant differences, and these observations were predictable because the children from Yogyakarta were more affluent than the children from Padang.

Comparison of growth of children of Padang, a fishing village, with the children of Bantul, an agricultural village

Although both Padang and Bantul are similar in socioeconomic status, the subject Padang children were consistently slightly taller and heavier than the Bantul children. The differences in height and weight were small between two groups of children; no statistically significant difference was detected except at age 7 in the boys. In terms of weight, however, the Padang boys were significantly heavier than the Bantul boys at ages 8, 10–12, and 14, whereas the Padang girls were so at age 15 only (Figure 3).

To the extent that height represents the long-term environmental influences on growth and weight represents the shorter-term influences (Waterlow et al., 1977), these comparisons may imply that the nutritional status of Padang children, who have a diet higher in rice and fish, and that of Bantul children, who have a diet higher in rice and vegetables, may contribute to the slight differences in their height and weight.

The results of this study demonstrate that the growth of Indonesian children is similar to that shown in the results obtained from other studies in various countries (Tanner, 1978; Eveleth and Tanner, 1990; Ashizawa et al., 1998; Castilho and Lahr, 2001; Eiben et al., 2005). Namely, the living conditions in a city tend to be more advantageous than those in fishing or agricultural areas for the growth of children. As has been noted by Tanner (1989), children in urban areas are usually larger and displayed a more rapid rate of growth than children in the villages of the surrounding countryside.

The children in the fishing village of Padang were smaller in both height and weight than those in Yogyakarta, a big urban area. These observations were predictable because the children of Yogyakarta were from families belonging to a privileged socioeconomic class in Indonesian society, and have all the advantages for a growing child—better employment for parents, good sanitary conditions, more sophisticated healthcare, etc. In contrast, the subject children in Padang were from families belonging to a less privileged socioeconomic class. Smaller differences in growth between the subject children in Padang and the children in Bantul were found; this is unsurprising given the very similar socioeconomic status of the two areas. The results of our study in Indonesia are in accord with a hypothesis that improvement in socioeconomic conditions is the main contributing factor to children’s growth and development.

Limitations and future research

The study contains limitations that are important to acknowledge. Only parental occupation and medical history were used to collect information from subjects. It is important to collect data on subjects’ nutrition, hygiene, and medical services in relation with environmental influences on growth.

Future studies might also examine the possibility of the cultural difference in growth patterns between urban and countryside populations.

Acknowledgments

We would like to express heartfelt thanks to the directors, teachers and especially children of the elementary and junior high school in Bungus Teluk Kabung, Padang, Yogyakarta, and Imogiri, Bantul Indonesia.

References


