Berkala Ilmu Kedokteran
Vol. 39, No. 4, Desember 2007: 177-185

Somatotypes of children in different areas of Indonesia

Rahmawati NT[1]., Hastuti J[1]., Yevita N[2]., and Ashizawa K[3].
[1]Departement of Anatomy, Embriology and Anthropology
School of Medicine, Gadjah Mada University, Yogyakarta.
[2]Department of Anthropology, Faculty of Social and Politic, Andalas University, Padang.
[3]Otsuma Women' University, Tokyo Japan.

ABSTRACT

Neni Trilusiana Rahmawati, Janatin Hastuti and Yevita Nurti – ***Somatotypes of children in different areas of Indonesia.***

Background: Human populations consist of individuals who differ widely in body shape and size. Somatotypes are morpho-phenotypic ranges along continua of variation, which possess constantly recognizable characteristics and are the functional end products of the whole genetic and the developmental complex. **Objective:** The objective of this cross-sectional study was to establish the somatotypes of urban, agricultural and fishing village children in Indonesia.
Method: Anthropometric somatotypes of children are considered in a cross-sectional sample of school-going, ranging in age from 7-15 years. A total numbers 1716 (816 boys and 900 girls) consist of children in urban Yogyakarta (340 boys and 371 girls), agricultural Bantul (222 boys and 243 girls), and fishing Padang (254 boys and 286 girls). Heath-Carter somatotypes were determined for all subjects.
Result: The Yogyakarta children were taller and heavier than their agricultural and fishing counterparts in both sexes. The Yogyakarta children (urban) were more endomorphic, mesomorphic, and less ectomorphic than the Bantul and Padang children. The Padang children (fishing village) were more ectomorphic and less endomorphic than the Yogyakarta and Bantul children. The mean somatotype of boys and girls were 3.8 – 3.6 – 3.7 and 4.2 – 3.1 – 3.6 (in urban city, respectively), 2.8 – 3.2 – 4.1 and 3.5 – 2.9 – 3.9 (in an agricultural village, respectively), and 2.5 – 3.5 – 3.8 and 3.5 – 3.1 – 3.5 (in fishing village, respectively).
Conclusion: The finding indicated among the Indonesian children, the distribution of somatotype according to age was different between urban Yogyakarta, agricultural Bantul and fishing Padang. In general, the well-off children were more endomorphic, and the low-income children were more ectomorphic.

Key words: somatotype anthropometric – urban, agricultural, and fishing village children

ABSTRAK

Neni Trilusiana Rahmawati, Janatin Hastuti and Yevita Nurti – ***Somatotipe anak-anak Indonesia di daerah yang berbeda.***

Latar belakang: Populasi manusia terdiri atas individu-individu yang berbeda secara luas dalam bentuk dan ukuran badan. Somatotipe merupakan morfo-fenotip yang kisaran variasinya berlansung secara terus-menerus, sebagai hasil dari faktor genetik dan perkembangan yang kompleks, namun demikian ciri-ciri tersebut tetap dapat dikenali.
Tujuan: Tujuan dari penelitian cross-sectional ini adalah untuk mengetahui somatotipe pada anak-anak urban, rural pertanian, dan nelayan di Indonesia.
Metoda: Somatotipe antropometris anak-anak diperoleh dari penelitian secara cross-sectional pada anak-anak sekolah umur 7-15 tahun. Jumlah subjek penelitian adalah 1716 (816 anak laki-laki dan 900 anak perempuan) terdiri atas anak-anak di daerah urban Yogyakarta (340 anak laki-laki dan 371 anak perempuan), rural pertanian Bantul (222 anak laki-laki dan 243 anak perempuan), dan anak-anak nelayan Padang (254 anak laki-laki dan 286 anak perempuan). Penentuan somatotipe dilakukan terhadap semua subjek penelitian dengan metode Heath-Carter.

Rahmawati NT, Departement of Anatomy, Embriology and Anthropology,
Faculty of Medicine Gadjah Mada University, Yogyakarta.

Hasil: Anak-anak di daerah urban Yogyakarta lebih tinggi, berat, endomorfik dan mesomorfik, serta kurang ektomorfik dibandingkan anak-anak Bantul dan Padang. Anak-anak Padang lebih ektomorfik dan kurang endomorfik daripada anak-anak Yogyakarta dan Bantul. Rerata somatotipe anak laki-laki dan perempuan adalah 3,8 – 3,6 – 3,7 dan 4,2 – 3,1 – 3,6 (pada anak-anak urban), 2,8 – 3,2 – 4,1 dan 3,5 – 2,9 – 3,9 (pada anak rural pertanian Bantul), and 2,5 – 3,5 – 3,8 dan 3,5 – 3,1 – 3,5 (pada anak-anak nelayan Padang).

Simpulan: Hasil penelitian menunjukkan bahwa pada anak-anak Indonesia, distribusi somatotipe menurut umur berbeda antara anak-anak daerah urban Yogyakarta, pertanian rural Bantul, dan nelayan Padang. Secara umum, anak-anak dari kalangan mampu lebih endomorfik, sedangkan anak-anak dari kalangan kurang mampu cenderung lebih ektomorfik.

INTRODUCTION

Anthropometric somatotype studies have gained impetus in the last two decades following the introduction of a simplified method for somatotyping by Carter and Heath . The Heath-Carter phenotypic somatotype ratings, covering as they do wide variations in shape, absolute and relative size, and body composition, are well suited for analyzing the widely recognized changes in human beings during growth, maturation and the processes of aging[1]. Earlier research focused mainly on adults and athletes, and has indicated that the somatotype is influenced by a number of factors, such as age, sex, body composition, physical activity, smoking, and nutrition and high/low altitude[2]. Somatotypes vary among population groups as well as during growth in the same population[1.3].

The somatotype during childhood is characterized as part of changing of the body according growth and development. The foregoing data show that somatotypes of individual children are subject to significant changes during childhood and adolescence. It also appears that the physiques of some children are fairly stable over some periods in their growth. In general, it is evident that boys are more mesomorphic and less endomorphic than girls; these differences increase after adolescence[1].

Somatotype research in children is important, because they exhibit different somatotype patterns from adults. Somatotype rating are well suited for analysing the widely recognized changes in human beings, during growth, maturation and process of aging[1.3.4]. However, so far as we know, studies on somatotypes children have been limited in number especially in Indonesia[4.5.6]. Although there are some changes in somatotype between ages 6 to 12, there are greater changes during adolescence and into adulthood[1]. Several large cross-sectional somatotype studies have been done[2.7.8.9.10.11], but there are no definitive data on the different ecological (urban, agricultural and fishing areas) on the somatotypes of Indonesian children. Therefore, the purpose of this study was to describe the somatotypes of children in urban, agricultural and fishing areas in Indonesia.

MATERIALS AND METHODS

The present cross-sectional data are based on sample of school-going, ranging in age from 7-15 years. A total number of 1716 (816 boys and 900 girls) from three different areas of Indonesian children, consisted of fishing, urban, and rural children. The data of urban and agricultural children in Yogyakarta (340 boys and 371 girls), and Bantul (222 boys and 243 girls) were obtained in November 1999 and 2001, and the data of fishing children in Padang (254 boys and 286 girls) were obtained in January 2006. In all groups, the majority of the children's families were Islamic.

All subjects were physically and mentally normal and did not suffer from any apparent illness at the time of data collection. Date of birth of each student was recorded not only from school registers but was verified from the students. The data so collected were grouped into 9 decimal age groups of one year interval. Specially designed questionnaires were used to elicit information from participating subjects about their age, sex, date of birth, medical history, socio-economic, parent's occupation, educational and income status. Before measurements, the subjects gave sign on the letter of informed consent.

Stature and weight were measured in the morning as far as possible. As all of the children came from Islamic families, they could not to be examined wearing the minimum clothing during the examination; especially the girls had to keep the traditional scarf and long skirt. We measured the weight of their clothing, and subtracted this weight from the body weight for each child: i.e. 400 grams for the elementary school boys and girls, 450 grams for the high school boys, and 500 grams for the high school girls. The weight presented in the table in Results reflects incorporates takes into account of the subtraction.

Children deviating by more or fewer than +/-3SD in each age group and each sex in Yogyakarta, Bantul, and Padang respectively were excluded, and we executed again the descriptive statistics of which the results were given in the tables of the results and discussion in this chapter.

The following 10 body measurements were obtained for each subject employing the method described in Carter and Heath[1], i.e. on right side measurements for four limbs. The distribution pattern was examined for 10 measurements in each age group and each sex in each examination area. When more than 2/3 of the age groups for a measurement and of a given sex was determined as normal, the distribution pattern of this measurement as a whole was considered as normal. As a result, all measurements presented normal distribution in both sexes. Therefore Scheffe multiple comparison was used to examine the regional difference, and the t-test for the sex difference.

The somatotype components of the individual subjects were calculated according to the Heath-Carter method (Carter[12], Carter and Heath[1]).

RESULTS AND DISCUSSION

The descriptive statistics for the boys and the girls are presented in TABLE 1. FIGURE 1 shows the comparison of the three somatotype components of the boys and girls in the 3 areas. FIGURE 2 shows comparison of the three somatotype components between boys and girls in the three areas (Yogyakarta, Bantul, and Padang) children.

The age group somatotypes in each sample were plotted on a somatochart (FIGURE 3) and the patterns of somatotype group were observed.

TABLE 1 shows that the urban boys and girls were taller and heavier than their agricultural and fishing counterparts in both sexes. FIGURE 1 shows regional differences among urban (Yogyakarta), agricultural (Bantul) and fishing (Padang) for each somatotype component. We can see that the Yogyakarta children were more endomorphic from 7 to 15 years of age, except the girls at age 10. Concerning in the second component, the Yogyakarta children were the more mesomorphic until age 11 in both sexes than Bantul and Padang children. After age 12, the Padang boys were more mesomorphic than other two areas, the Bantul boys were more mesomorphic than the Yogyakarta boys, and the same tendency was found in the girls as well. As for the third component, the Padang boys were more ectomorphic than the Yogyakarta and Bantul boys at age 10. The Bantul boys were more ectomorphic than the Yogyakarta boys from age 8 to 11 years. As for the girls, the Yogyakarta girls were more ectomorphic only at 10 year than other two areas.

Concerning regional differences, we could summarize in brief that Yogyakarta children were more endomorphic than Bantul and Padang children from age 7 to age 15 in both sexes, but from 12 years the Yogyakarta children were less mesomorphic than Bantul and Padang children. As for the third, the Yogyakarta boys were less ectomorphic than Bantul and Padang boys after age 13. In the three areas, for boys, there was a some tendency that at the second component decreased after age 11 years, and at the third component increased after 12 years. However, for the girls, there was a some tendency to increase at the first component from 11 years, and decrease at the second component from 12 years.

FIGURE 2 presents the sex difference of each component in Yogyakarta, Bantul and Padang children, respectively. In the three areas, Yogyakarta, Bantul, and Padang, the boys showed a decreasing endomorphic score after the aged 12. In contrast, the girls showed a somewhat increasing endomorphic score according to age. However, a sudden decrease in the mean score at age 10 in the girls especially from Yogyakarta, needs further investigations, that must be conducted in relation to female pubertal events, such as, menarcheal age.

TABLE 1. Mean values and standard deviations of somatotype scores in Yogyakarta, Bantul and Padang children.

	Variables	Age	7 yr	8 yr	9 yr	10 yr	11 yr	12 yr	13 yr	14 yr	15 yr
Yogyakarta		N	34	17	35	33	21	34	49	73	44
Boys	Height	Mean	121.20	125.40	128.60	135.40	144.80	145.70	150.90	158.80	160.70
		SD	4.57	4.57	4.55	6.04	9.47	7.66	9.37	7.85	7.71
	Weight	Mean	22.40	26.40	25.90	30.70	39.30	36.70	38.80	44.90	45.20
		SD	4.12	8.29	4.97	6.26	10.49	9.15	8.68	9.00	7.09
	K1	Mean	3.80	4.21	3.84	3.95	4.64	3.69	3.42	3.37	2.91
		SD	1.45	1.67	1.41	1.38	1.59	1.44	1.27	1.29	1.05
	K2	Mean	4.70	5.13	4.36	4.36	4.25	3.11	2.18	2.04	1.81
		SD	0.74	1.22	0.82	0.89	0.91	1.43	1.02	1.23	0.94
	K3	Mean	3.17	2.83	3.46	3.36	2.95	3.88	4.34	4.37	4.59
		SD	1.39	1.50	1.36	1.55	1.36	1.52	1.39	1.57	1.32
		N	25	21	22	24	23	48	85	77	48
Girls	Height	Mean	119.30	124.30	130.20	131.70	142.90	146.30	149.90	152.20	152.40
		SD	4.53	5.21	5.91	4.98	6.60	7.06	6.50	4.66	5.39
	Weight	Mean	20.80	24.70	27.90	24.50	36.50	37.20	40.10	41.80	43.30
		SD	3.27	7.41	7.24	2.97	8.60	7.93	7.13	7.58	5.96
	K1	Mean	3.71	4.00	4.26	3.36	4.37	4.17	4.49	4.60	4.73
		SD	1.14	1.75	1.73	1.49	1.59	1.32	1.31	1.21	1.01
	K2	Mean	4.38	4.58	4.18	3.44	3.73	2.26	1.93	1.73	2.06
		SD	0.96	1.19	1.19	0.86	0.95	0.96	1.21	1.22	1.04
	K3	Mean	3.38	3.28	3.33	4.73	3.27	3.79	3.72	3.78	3.34
		SD	1.51	1.64	1.92	1.49	1.58	1.45	1.59	1.64	1.29
Bantul		N	34	17	35	33	21	34	49	73	44
Boys	Height	Mean	115.10	119.50	124.90	129.50	131.90	137.20	142.60	152.30	153.50
		SD	5.15	3.83	5.18	6.36	5.63	8.1	7.73	8.77	8.57
	Weight	Mean	18.30	19.30	22.50	25.10	26.00	30.20	32.50	40.40	40.40
		SD	2.34	2.04	3.55	5.32	3.9	6.94	6.55	7.26	10.01
	K1	Mean	3.13	2.61	2.96	3.03	2.97	3.02	2.70	2.39	2.34
		SD	0.41	0.53	0.62	0.96	0.91	1.19	1.02	0.66	0.63
	K2	Mean	3.55	3.45	3.55	3.47	3.11	3.24	2.87	3.00	2.72
		SD	0.82	0.86	0.78	0.96	1.07	1.43	1.29	0.99	0.85
	K3	Mean	3.49	4.14	3.97	4.03	4.19	3.92	4.35	4.09	4.47
		SD	0.93	1.15	1.24	1.21	1.23	1.24	1.22	1.02	1.05
Girls		N	17	36	41	35	23	28	20	28	15
	Height	Mean	113.30	119.00	124.90	129.30	135.40	142.00	145.60	149.30	148.50
		SD	4.16	5.74	6.76	6.20	8.68	7.55	5.32	6.11	5.77
	Weight	Mean	18.00	19.50	22.30	24.40	28.30	33.10	35.30	38.50	39.90
		SD	1.98	3.06	3.68	4.59	6.54	6.61	5.98	5.55	5.79
	K1	Mean	3.19	3.26	3.42	3.61	3.19	3.56	3.33	3.81	3.96
		SD	0.54	0.87	0.87	0.91	0.78	0.69	0.87	1.13	1.21
	K2	Mean	3.64	3.28	3.34	2.96	2.89	2.88	2.33	2.27	2.48
		SD	0.69	0.91	0.89	0.94	1.05	0.89	0.89	1.22	1.02
	K3	Mean	3.16	3.96	4.03	4.29	4.19	4.03	4.12	3.95	3.37
		SD	0.74	1.26	1.16	2.26	1.39	1.26	1.19	1.31	1.27
Padang		N	34	17	35	33	21	34	49	73	44
Boys	Height	Mean	120.20	121.00	127.80	128.20	134.10	138.40	144.70	152.10	155.50
		SD	5.33	5.42	5.80	7.17	5.20	8.58	8.36	8.71	8.59
	Weight	Mean	20.40	20.80	26.00	23.20	28.90	30.40	36.20	41.00	43.30
		SD	2.53	2.67	4.41	3.05	5.46	7.03	7.44	8.50	6.94
	K1	Mean	2.62	2.21	2.95	2.18	2.87	2.44	2.52	2.39	2.19
		SD	0.91	0.52	0.78	0.36	1.43	0.80	1.09	1.06	0.64
	K2	Mean	3.57	3.59	3.66	3.24	3.66	3.21	3.53	3.33	3.43
		SD	0.63	0.58	0.25	0.50	0.88	0.90	0.90	0.90	0.64
	K3	Mean	3.72	3.71	3.16	4.39	3.62	4.12	3.73	3.94	3.97
		SD	0.83	0.64	0.84	0.71	1.47	1.02	1.36	1.31	0.92
Girls	N	N	12	15	23	29	22	24	48	60	53
	Height	Mean	112.90	117.60	124.20	127.70	134.60	141.20	146.70	150.50	151.70
		SD	3.13	4.53	4.97	6.18	7.09	6.72	6.73	5.47	5.65
	Weight	Mean	17.40	20.00	22.60	23.70	30.20	33.70	39.20	41.60	45.20
		SD	2.56	2.92	4.39	3.89	6.95	7.66	7.69	6.30	7.27
	K1	Mean	3.19	3.04	3.14	2.95	3.43	3.50	3.97	3.95	4.57
		SD	0.74	0.63	1.17	0.65	0.82	1.32	1.29	1.23	1.29
	K2	Mean	3.27	3.44	3.30	3.09	3.33	2.97	2.66	2.74	2.98
		SD	0.68	0.33	0.62	0.51	0.73	0.81	0.99	0.96	0.95
	K3	Mean	3.48	3.27	3.77	4.12	3.33	3.70	3.29	3.41	2.82
		SD	1.51	0.95	1.10	1.03	1.20	1.32	1.46	1.41	1.32

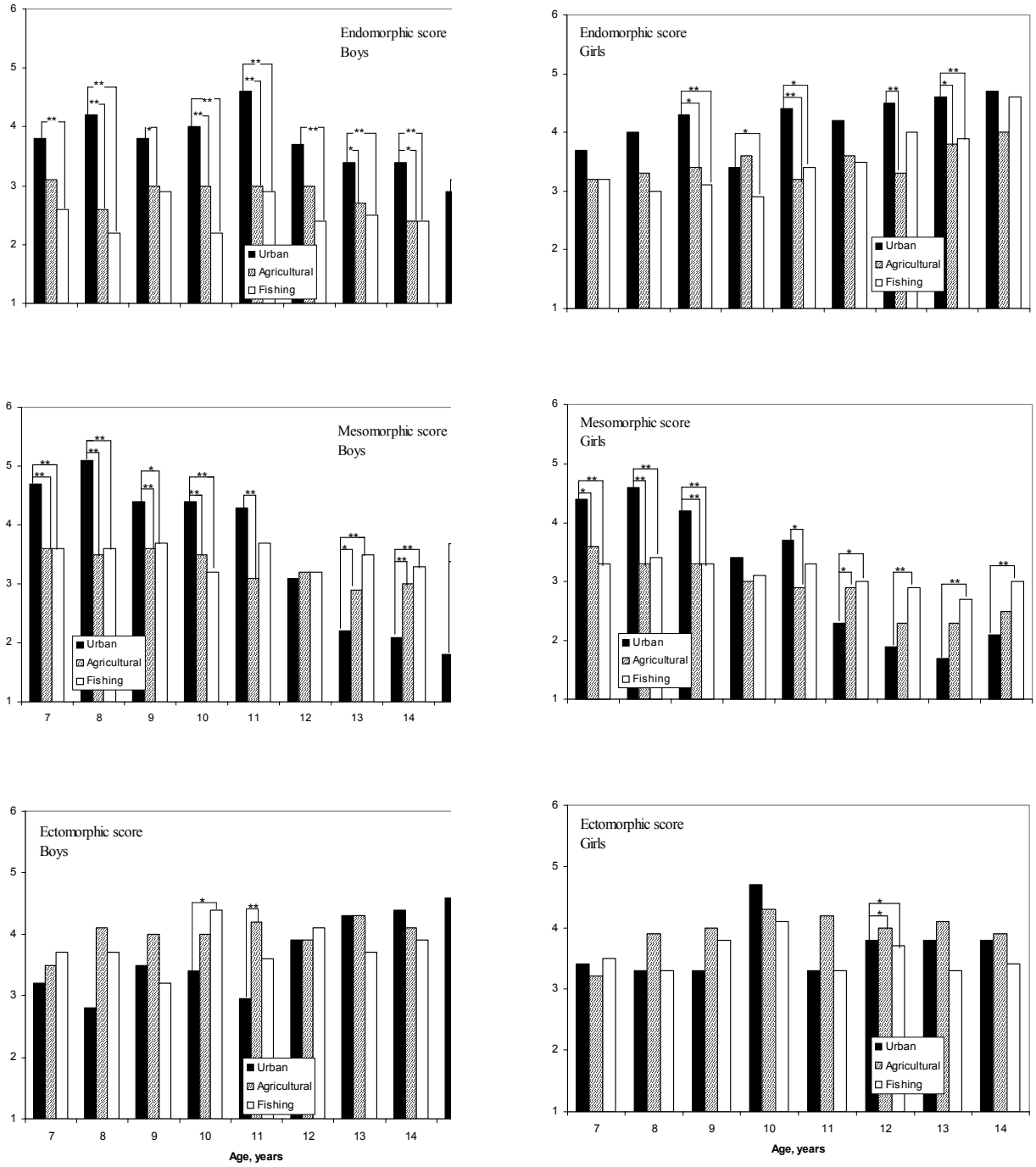

FIGURE 1. Regional difference of endomorphic, mesomorphic, and ectomorphic scores among Yogyakarta, Bantul, and Padang children (*p<0.05; **p<0.01).

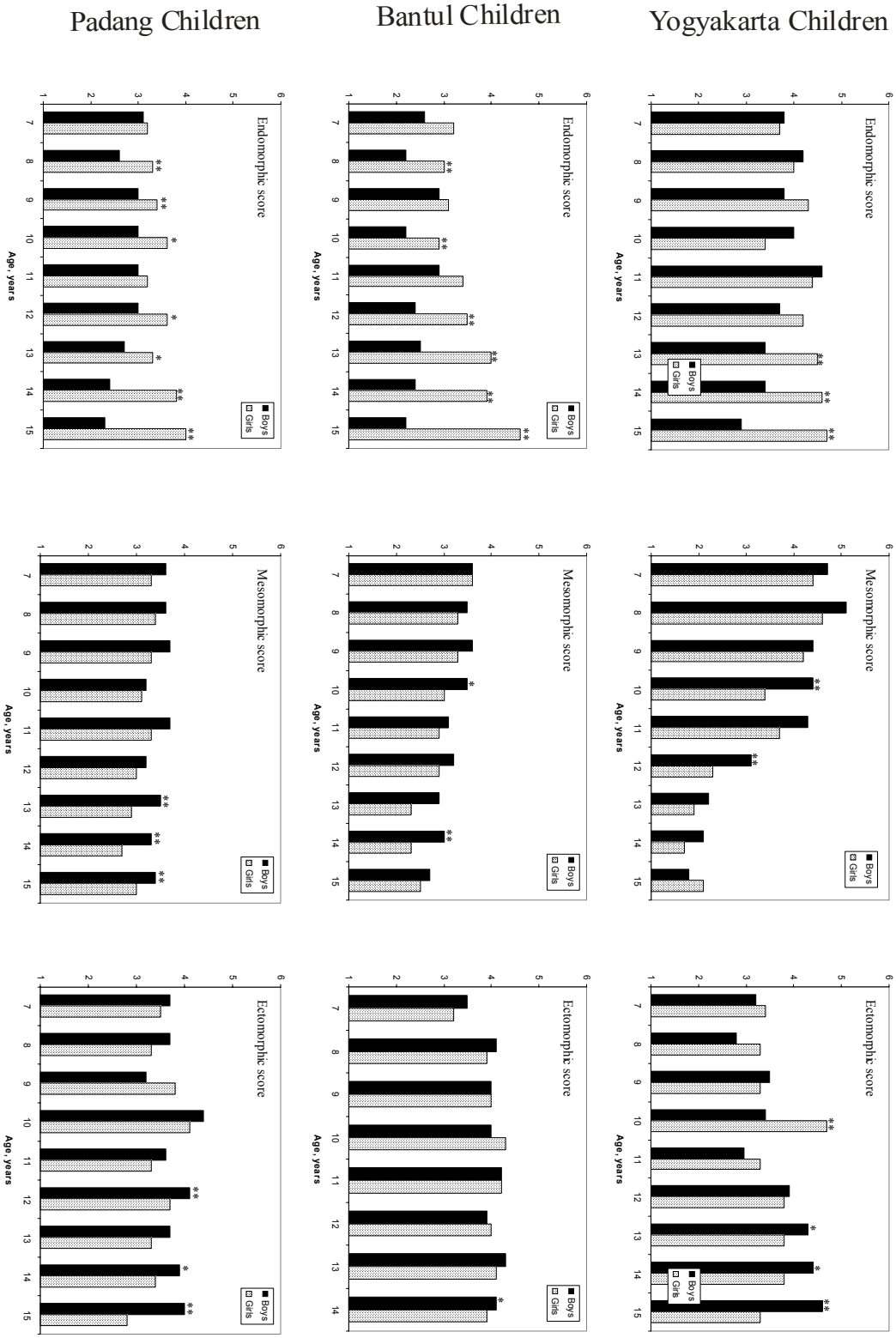

FIGURE 2. Sex difference of endomorphic, mesomorphic and ectomorphic scores in Yogyakarta (YC), Bantul (BC), and Padang children (PC) (*p<0.05, **p<0.01).

As for the second component, mesomorphy decreased according to age in both sexes in both regions, i.e. Yogyakarta and Bantul. However, in Padang children, the mesomorphy score was relatively stable according to age in both sexes, the boys were significant difference and more mesomorphic than girls at ages 13 to 15. In Yogyakarta children, this decrease and the sex difference were emphasized. In Bantul, in contrast, the decrease was gentle and the sex difference was small, except at ages 10 and 14. As a result, we note that the sex difference, i.e. less endomorphy in boys and more endomorphic in girls.

Concerning the third component in Yogyakarta, the girls of age 10 were more ectomorphic, but after age 12 the boys were more so. This sex difference at age 10 was paired with that of the mesomorphic scores of the same group, that is to say, the presence of more mesomorphic and less ectomorphic in boys than in girls. Moreover, the sex difference after age 12 was paired with that of the endomorphy score; namely, the presence of less endomorphic and more ectomorpic in boys than in girls. In the Bantul children, no significant sex difference in the ectomorphic score was detected, except at age 15. From figure 5, we observe that in Padang children, this sex difference at ages 12, 14, and 15 years, the girls were consistently less ectomorphic than the boys, where the boys were greater than the girls on ectomorphy were 0.9 units at age12, 0.3 units at age 14, and 1.7 units at age 15.

Most of the differences between the means of the somatotype components seem to be attributable to Yogyakarta urban children, the well-of groups of children, while Bantul and Padang children were lived in low socio-economic status. The apparently greater endomorphy and sum of skin folds of Yogyakarta children might be explained in terms of the higher socio-economic status. Yogyakarta children were more affluent than the children from agricultural and fishing area.

On the basis of the statistical analysis and the graphs of the means of the component for all groups, some general tendencies can be observed. Endomorphy appeared to be lowest at 15 years in the boys, and higher before of this age. In contrast, endomorphy was highest at 15 years, and lower before this age in the girls. These observations were predictable because the girls were greater in weight than in the boys during puberty, and girls tend to accumulate more fat than boys. The results of the study was supported by Forbes[13] suggested that the boys and girls both gain body fat in early adolescence; later the gain stops, even reverses temporarily in boys, while girls continue to put on fat as adolescence proceeds.

On mesomorphy, that is interesting to note at age 12 in all groups, a tendency to drop and increase again through year 15. As the skeleton is increasing more rapidly in length than in breadth during mid-adolescence, and as the hormonal influence on the development of muscle tissue is only beginning to have its effect.

In all groups, the general trend in ectomorphy was for the highest values at age 15 years for the boys occured in mid-adolescence when the maximum growth spurt was present. Contrast with the girls the trend for the highest values in ectomorphy was at age 10 in the beginning of puberty.

In brief, with regard to regional differences we can summarize that Yogyakarta children were more endomorphic, mesomorphic, and less ectomorphic than Bantul and Padang children. However, the Padang children were more ectomorphic and less endomorphic than Yogyakarta and Bantul children. With regard to sex difference, the Yogyakarta girls had higher endomorphic and lower ectomorphic scores than the boys from the same region. The Bantul girls had higher endomorphic and lower mesomorphic and ectomorphic scores than the boys, while the Padang girls had higher endomorphic and lower mesomorphic and ectomorphic than the boys from the same region. Similar results were presented in several studies[1.7.14.15].

Somatotype

Based upon the mean values of each component score, we determined the X and Y coordinates in order to plot the mean somatotype on the Carter's somatochart (FIGURE 6). We note here that the Yogyakarta children before puberty were distributed halfway between endomorphy and mesomorphy in both sexes, and thereafter the boys tended toward ectomorphy and the girls tended toward endomorphy.

However, the Bantul children were distributed in ectomorphy, except the girls of ages 7 and 15. However, we notice a different tendency depending on sex, divided by the ectomorphy axis; i.e., the boys were distributed in ectomorphy with a mesomorphic element, but the girls with an endomorphic element.

We notice also that the elder children in Bantul were more ectomorphic than the younger ones in both sexes, except the girls of age 15.

As for Padang children, the mean somatotypes of the boys shifted from ecto-mesomorphy to meso-ectomorphy, while the girls shifted from center to meso-endomorphy. A comparison of Padang and Bantul village with data in Stepnicka 1976 (mean somatotypes for Czecholovak children at 8-14 years) and Szmodis 1977 on 1400 children of both sexes aged between 5-17 years (in Heath & Carter[1]) show similar somatotype pathways, especially in later ages, slightly lower in mesomorphy.

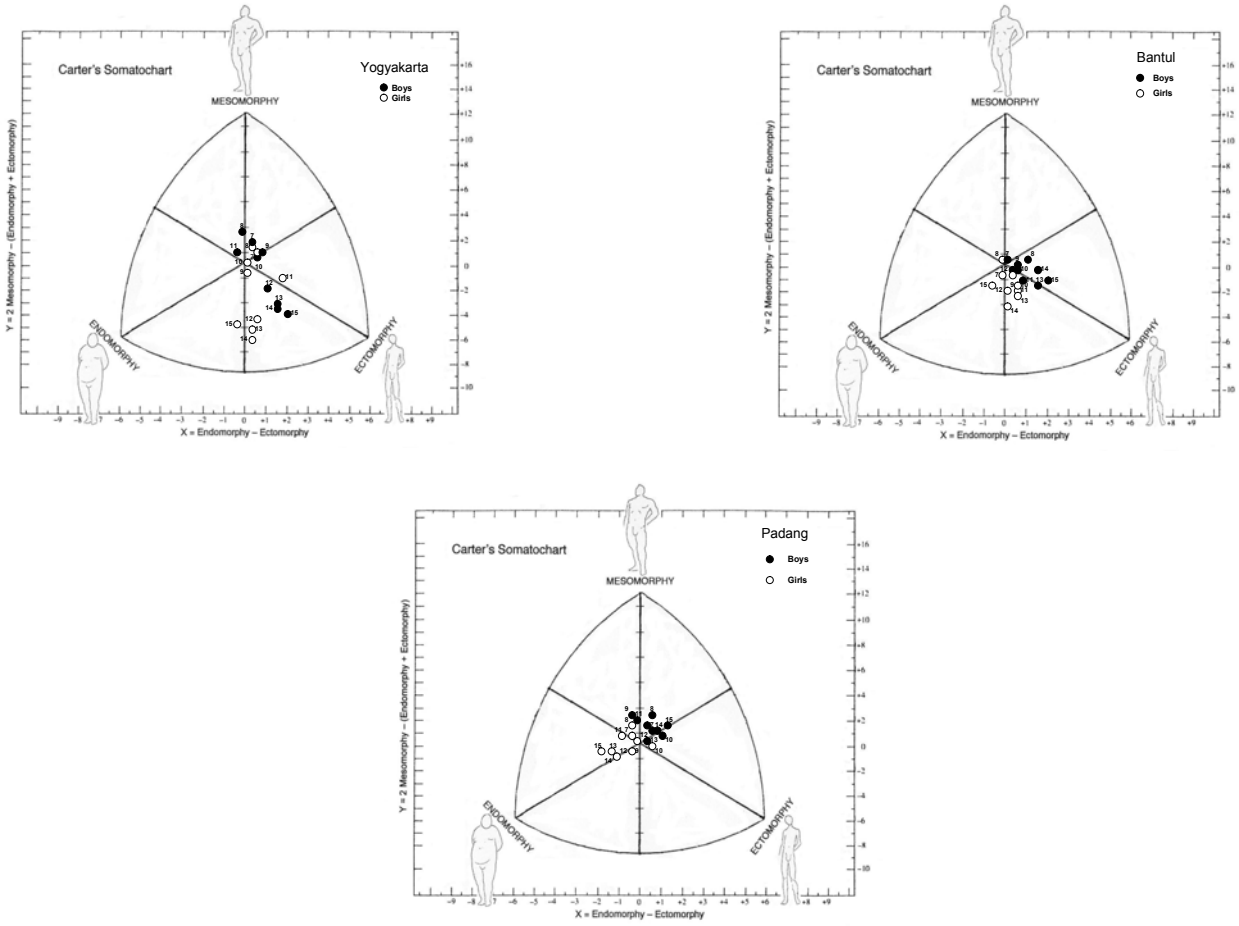

FIGURE 3. Mean somatotype of children in Yogyakarta, Bantul, and Padang village by age, 7 to 15 years old.

These cross-sectional observations suggest three phenomena. First, the somatotype of well-off children shifts in puberty from endo-mesomorph to ectomorphy in boys, and to endomorphy in the girls. Second, the somatotype of lower-income children remains ectomorphic both before and after puberty, but the girls after puberty seem to shift to endomorphy while the boys become more and more ectomophic according to age. Third, the somatotype of other lower-income children, we mean Padang children, the boys were appeared to be concentrated around mesomorph-ectomorph both before and after puberty, however the girls before puberty tended toward central, and after puberty seem to shift to endomorphy. Several factors may contribute to the differences of somatotype distribution

between Bantul and Padang villages. There was wide range of environment between those villages, the lifestyle i.e. physical activity, diet, and the samples had different ethnic backgrounds.

CONCLUSIONS

On the basis of the analysis and within the limitations of the study, the following findings appear to be concluded that:

1. The Yogyakarta children were taller and heavier than their agricultural and fishing counterparts in both sexes.
2. The Yogyakarta children (urban) were more endomorphic, mesomorphic, and less ectomorphic than the Bantul and Padang children.
3. The Padang children (fishing village) were more ectomorphic and less endomorphic than the Yogyakarta and Bantul children.
4. Among the Indonesian children, the distribution of somatotype according to age was different between urban Yogyakarta, agricultural Bantul and fishing Padang.
5. The mean somatotype of boys and girls were 3.8 – 3.6 – 3.7 and 4.2 – 3.1 – 3.6 (in urban city, respectively), 2.8 – 3.2 – 4.1 and 3.5 – 2.9 – 3.9 (in an agricultural village, respectively), and 2.5 – 3.5 – 3.8 and 3.5 – 3.1 – 3.5 (in fishing village, respectively).
6. In general, the well-off children were more endomorphic, and the low-income children were more ectomorphic.

ACKNOWLEDGMENTS

The authors are grateful to express heartfelt thank to Prof. Kumi ASHIZAWA, Prof. Teuku Jacob, and the Dean of Medical Faculty, Gadjah Mada University for providing the necessary facilities to carry out this study. I am also thankful to the pupils, teachers and headmasters of the following schools i.e. SD Ungaran 2 and SMPN 12 Yogyakarta, SD and SMP 2 Imogiri Bantul, and SDN 1 and SMPN 9 Bungus Teluk Kabung, Padang for their kind participation during this research.

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