ORIGINAL ARTICLE

The Anthropometric Measurements and Percentile Curves of Children Aged 0–5 Years in Eastern Turkey

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ABSTRACT

Objective: *To determine the growth reference value of children in our province and to compare these values with current values of the USA and other local values of our country.*

Methods: *A total of 615 boys and 586 girls with different socioeconomic levels and ages of 0–5 years were included in the study. In all children, weight, height, head circumference, abdominal circumference, hip circumference, mid-arm circumference, and lower segment length were taken. All measurements were performed by the same paediatrician. The lambda-mu-sigma method was used for the preparation of percentile curves.*

Results: *The body weight, head circumference and chest circumference measurements of boys were significantly higher than those in girls. Anthropometric measurements of children in high-income groups were higher than those in the low-income group. All of the anthropometric parameters except upper mid-arm circumference were higher in children fed with breast milk and formula milk than in children who only fed with breast milk. The relation between the mother's education level and anthropometric parameters was insignificant.*

Conclusion: *Our results showed that the anthropometric measurements of our children were similar to those of west Turkey as well as those of the United States. On the other hand, our children's anthropometric measurements were higher than other local values. Relatively high values of height have been interpreted as a genetic feature.*

Keywords: Anthropometric measurements, children, percentile curves.

INTRODUCTION

Anthropometric data for children encompass various human body measurements, for example, weight, height and size, including skinfold thicknesses and lengths. Anthropometry is a key component of nutritional status assessment in children and adults (1). In children, anthropometric measurement is used to monitor growth and determine insufficient and unbalanced nutrition that enable early identification and prevention in a variety of diseases (2). Our aim is to determine children's growth reference value in our province and to compare these values with current values of the USA and other local values of our country.

MATERIALS AND METHODS

This cross-sectional study was conducted in children with different socioeconomic levels from kindergarten and crèche and in healthy children who were admitted to health centre for vaccination after obtaining written permission from the health director and families. A total of 1201 children (586 girls and 615 boys) aged 0–5 years and had no known chronic disease were enrolled in the study. The anthropometric measurements of all children enrolled in the study were performed by the same paediatrician. Body weight, height, head circumference, upper mid-arm circumference, chest circumference, abdominal circumference, hip circumference, and lower

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segment length were measured and recorded. Body mass index (BMI) was calculated as body weight (kg) divided by square height (m^2). The chronological age of children was calculated and recorded as decimal years.

Additionally, family income, duration of breastfeeding and onset time of taking additional food were also recorded. The percentile curves of all children were determined using the lambda-mu-sigma Chart Maker Pro version 2.3 software program (The Institute of Child Health, London). The effects of gender difference and additional food intake on anthropometric measurements were analysed using Chi-square and one-way analysis of variance test. The results were expressed as mean ± standard deviation when applicable. A p value of < 0.05 was considered significant.

RESULTS

The present study included 586 (48.8%) girls and 615 (51.2%) boys. The mean ages of children were 29.72 ± 22.32 months in boys and 30.03 ± 21.94 in girls. No statistically significant difference was found with regard to age and gender ($p > 0.05$). The distribution of anthropometric measurements of children according to gender is shown in Table 1. On comparing anthropometric measurements in terms of gender, it was found that boys had higher body weight, head and chest circumference than girls. When compared in terms of family income, it was observed that the anthropometric measurements of children who had high family income were higher than those who had low family income. A statistically significant difference was also found when comparing children who were given breastfeed plus formula with those who were given only breastfeed. The relation between the mother's education level and anthropometric parameters was insignificant. A Comparison of our data with other studies in Turkey and other countries is shown in Table 2.

Table 1: The comparison of anthropometric measurements of children according to gender

	Gender	n	Mean	SD	*p*
Body weight	Boys	598	12.09	5.53	0.04
	Girls	558	11.49	5.00	
Height	Boys	598	85.13	19.22	> 0.05
	Girls	558	84.36	18.73	
Head circumference	Boys	598	46.94	4.61	0.002
	Girls	558	46.08	4.59	
Upper mid-arm circumference	Boys	598	15.34	2.51	> 0.05
	Girls	556	15.26	2.40	
Abdomen circumference	Boys	598	45.40	7.26	> 0.05
	Girls	558	45.04	6.93	
Hip circumference	Boys	598	48.46	8.70	> 0.05
	Girls	558	48.41	8.68	
Chest circumference	Boys	598	49.13	6.82	0.006
	Girls	558	48.06	6.19	
Lower segment length	Boys	598	38.77	11.60	> 0.05
	Girls	558	38.86	11.17	

SD = standard deviation

DISCUSSION

Anthropometric assessment continues to be one of the most-used methods for evaluating and monitoring health status, nutritional state and growth in children, not only of individuals but also of communities (3). Growth and development retardation secondary to malnutrition and vitamin and mineral deficiencies in the paediatric population have been demonstrated by several studies in Turkey (4). Body weight by age and height by age are the most frequently used measurements in assessing growth (5). Growth curves are the most important tools for the assessment of children's growth line, which could further helps to develop preventive interventions (6). The most prevalent growth curves are the NCHS/CDC curves (7, 8), which are acknowledged by the World Health Organization (WHO) as international standards, and curves that were developed by Neyzi *et al* (7) in Turkey. The ranges recommended by the WHO as "international growth standards" were derived from the measurements in children in the USA (9, 10). A comprehensive multicentre study including other regions has not been performed in Turkey (11). Yet, it has been reported that anthropometric measurement varies by time in developing countries and that the corresponding curves should be updated based on new data collected on a regular basis (12, 13). Although the standards recommended by the WHO are assumed to be valid during the first years of life for almost all countries, intercultural variations may be noted during these early years (14–16). The present study attempted to follow the criteria described by Waterlow *et al* and acknowledged by the WHO in obtaining anthropometric reference values in childhood. These criteria may be summarized as (a) sufficient number of measurements for each age group, (b) good selection of subject's representative of the general population, (c) reliable measurement methods, and (d) utilization of valid statistical methods for data analysis (10, 17, 18). The present study intended to interpret the results by comparing them with WHO data (19) and data from the US children (20, 21), and the data reported from the studies by Neyzi *et al* in Istanbul

Table 2: Comparison of anthropometric measurements of children our study and other studies

	Male								Female						
Anthropometric measurement	**Our study**	**Neyzi[7] (1978)**	**Neyzi[8] (2008)**	**Şehla[22] (2006)**	**Ayçiçek[11] (2005)**	**USA[20] (2000)**	**WHO[19] (2006)**	**Age**	**Our study**	**Neyzi[7] (1978)**	**Neyzi[8] (2008)**	**Şehla[22] (2006)**	**Ayçiçek[11] (2005)**	**USA[20] (2000)**	**WHO[19] (2006)**
Body weight (kg)	6.7	3.4	3.43	–	3.4	3.4	3.3	**0**	6.3	3.4	3.29	–	3.2	3.4	3.2
Height (cm)	64.9	50.6	50	–	50	50	49.9		63.3	50.2	49.4	–	50	49	49.1
Head circumference (cm)	43.1	35.3	34.9	–	–	35.8	–		42	34.7	34.5	–	–	34.7	–
Body weight (kg)	10.2	10	10.1	10	9.2	10.3	9.6	**1**	9.6	9.6	9.3	9	8.1	9.5	8.9
Height (cm)	78.6	74.7	76.9	77	74	75.5	75.7		77	73	75.1	75	73	73.8	74
Head circumference (cm)	46.8	47.3	47.1	47	–	46.3	–		45.5	45.8	45.8	45.5	–	45	–
Body weight (kg)	12.7	12.1	12.6	12	10.5	12.6	12.2	**2**	12.1	12.2	11.9	12	10	12.1	11.5
Height (cm)	88.5	84	88.2	86	81	85.5	87.1		87.2	85.5	86.8	84.7	80	85.3	85.7
Head circumference (cm)	48.8	49.7	49.3	48	–	48.6	–		47.7	48.1	48	47	–	47.5	–
Body weight (kg)	14.7	14.6	14.8	15.5	12.6	14.3	14.3	**3**	14.2	14	14.1	14	12	13.9	13.9
Height (cm)	96.5	95.3	96,8	96.7	89	95.8	96.1		95.5	95	95.4	95	88	94.7	95.1
Head circumference (cm)	49.9	50.4	50	50	–	49.5	–		48.9	49.3	48.7	49	–	48.4	–
Body weight (kg)	16.5	16.7	16.8	17	15	16.3	16.3	**4**	16	16	16,1	15	14	16	16.1
Height (cm)	104.4	102.5	104	103.5	95	102.8	103.3		103	102	102.5	101	95	101	102.7
Head circumference (cm)	50.5	–	–	50	–	–	–		49.7	–	–	49	–	–	–
Body weight (kg)	18	18.7	18.6	18	16.2	18.3	18.3	**5**	17.6	18.2	18.4	17.5	15	18.1	18.2
Height (cm)	111.1	109.5	110.4	109	102.5	109	110		110.8	108	109.1	108.2	104	107.4	109.4
Head circumference (cm)	50.9	–	–	50.5	–	–	–		50.3	–	–	49.5	–	–	–

(8, 15) and other local studies that were performed in Turkey (Table 2).

The median body weight by the age of the male children included in the present study was above the values described by the WHO (19) in all ages except for the age of 5 years. Compared to US children (20, 21), median body weight by age was higher in male children aged 2, 3 and 4 years in the present study. Median body weight by age in female children of the present study was higher across the first four ages compared to the female children in Istanbul studies. Compared to WHO data and US children, the median body weight by age of children in this study was higher across the first 3 years of age. The comparison of height by age with the values reported from previous studies (7, 8, 11, 19–22) demonstrated higher values for all ages in both the male and female children, excluding the male children aged 3 years in the present study. Relatively high values of height have been interpreted as a genetic feature.

Head circumference of the children in the present study was lower at the first three ages compared to the children in the Istanbul study (7, 8) and was higher compared to the US children (20, 21). This result, which is in accordance with those reported from other studies in Turkey, might be a genetic feature specific to our country, as has been discussed by Neyzi *et al* (8).

The comparison of BMI measurements of the children in the present study and the study by Neyzi *et al* (8) revealed lower BMI values for both the male and female children of the present study. The comparison of the male children in the present study and BMI criteria of the WHO (19) demonstrated higher values for ages 3, 4 and 5 years but lower values for ages 1 and 2 years. In the female children of the present study, BMI values were in accordance with the WHO data at ages 3 and 4 years but were lower than the WHO values for the remaining ages.

Upper arm circumference measurements of the children of the present study were higher in males for the first three ages in line with the literature (23), while it was higher in the female children of the present study on the contrary to the literature.

Upper segment–lower segment ratios of the female children below the age of 3 years and the male children of ages 3 and 5 years of the present study were higher compared to the values reported for the subjects in the study by Turan *et al* (24).

Compared to the reference ranges proposed by Feingold and Bossert (25), the median chest circumference values were higher for all ages in the children of the present study in the 0.9–1.6 cm range.

The comparison of the children in the present study with those in Istanbul study (26) in terms of abdominal circumference demonstrated higher values for children up to the age of 5 years in both genders and lower values for all other ages.

Previous studies have demonstrated a close association of children's nutritional status and therefore growth and development with their families' socioeconomic status (27–29). In a study by Garipağaoğlu and Günöz (4) in Istanbul, better height measurement relative to percentile curves were noted for children of families with better socioeconomic status. A study by Martorell *et al* (30) reported a positive impact of high socioeconomic level on growth and development. In the present study, the comparison by income status demonstrated significantly higher anthropometric measurements for children of families with higher incomes compared to those in the lower-income group, consistent with the literature. The analysis of the relationship between the anthropometric measurements of children and their nutritional patterns showed that the anthropometric measurements excluding mid-arm circumference were significantly higher in infants younger than 6 months receiving formulated milk with breast milk compared to those fed with breast milk only. Besides, all anthropometric measurements of children above 6 months receiving formulated milk in addition to normal feeding were significantly higher than those receiving normal nutrition. This positive impact on anthropometric measurements was attributed to the fact that the children being fed with formulated milk were from families with high educational and socioeconomic levels.

In conclusion, our results showed that the anthropometric measurements of our children were similar to those of west Turkey as well as those of the USA. On the other hand, our children's anthropometric measurements were found to be higher than other local values. Relatively high values of height have been interpreted as a genetic feature.

AUTHORS' NOTE

ES: study concepts, literature research, data acquisition and analysis, manuscript preparation. MD: literature research, manuscript editing. YS: study concepts, manuscript editing. SA: study concepts, manuscript editing. MB: data acquisition. AK: manuscript editing, literature research. MM: statistical analysis, manuscript editing. All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

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