PHYSICAL GROWTH MEASUREMENTS OF 18,719 PRIMARY SCHOOL CHILDREN LIVING IN ADANA, TURKEY*

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Height and weight measurements are considered basic criteria in monitoring the growth of children. For this reason, growth standards or nomograms which yield mean optimal values have been constructed for children in many developed countries[1]. But, similar standards have not yet been established for children in most developing countries including, Turkey. Several studies have been carried out to evaluate the development of Turkish children[2-7]. They reveal varied measurements since they reflect the social and environmental differences existing in various parts of Turkey.

The aim of this study is to establish local urban standards for Turkish children living in Adana whose ages range between six and fifteen years and to compare these results with the data gathered from studies carried out in other parts of Turkey and the USA, a developed country.

Material and Methods

This cross-sectional study was carried out in 1982 on 18,719 healthy children at 14 primary schools located in different parts of the city of Adana in order to establish the growth standards of children. Our study was part of a general concurrent study used to determine the frequency of congenital malformations. Since only healthy children were considered for our study, those with chronic diseases,

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neurological disorders, congenital malformations and poor nourishment along with children whose ages were doubtful, were excluded.

Measurements were taken under the supervision of a consulting pediatric surgeon and several senior residents. There were 9,135 girls and 9,584 boys whose ages ranged between six and fifteen years. Height and weight measurements were taken using standard portable equipment. The children wore only their underclothing when being weighed, and their height was determined while standing barefoot.

The mean and standard deviations were calculated for boys and girls. For each age and sex group, the 3^{rd}, 10^{th}, 25^{th}, 50^{th}, 75^{th}, 90^{th} and 97^{th} percentiles were calculated. The boys were divided into the 6-13 and 13-15 year-old age-groups while the girls were divided into the 6-12 and 12-15 year-old age-groups. The subjects were put into their respective age-groups because of the acceleration in weight and height after puberty. A third-degree regression analysis was used to obtain continuous curves for the two groups of boys and the two groups of girls for each percentile.

Results

The age and sex distributions of the children are shown in Table I. The mean and standard deviations of height and weight measurements of boys and girls for each age-group are shown in Tables II and III. Percentiles for boys and girls which are the result of third degree regression analysis are presented in Tables IV and V.

TABLE I: Age and Sex Distribution of Children

Age (yrs)	Boys	Girls
6	253	256
7	1372	1488
8	1807	1617
9	1500	1591
10	1654	1478
11	1393	1377
12	882	656
13	252	236
14	258	228
15	213	208
Total	9584	9135

TABLE II: Mean and Standard Deviation of Weight (kg) for Boys and Girls

Age (yrs)	Boys	Girls
6	21.00 ± 2.10	20.44 ± 2.40
7	22.61 ± 2.51	22.01 ± 2.51
8	25.31 ± 2.81	24.20 ± 2.70
9	27.29 ± 2.89	26.81 ± 3.11
10	30.21 ± 3.41	29.19 ± 3.79
11	33.11 ± 3.71	32.30 ± 4.20
12	35.51 ± 4.01	34.70 ± 4.80
13	38.20 ± 4.50	39.91 ± 5.51
14	44.39 ± 5.59	45.39 ± 5.59
15	50.71 ± 7.74	51.81 ± 5.81

TABLE III: Mean and Standard Deviation of Height (cm) for Boys and Girls

Age (yrs)	Boys	Girls
6	115.93 ± 4.64	115.16 ± 4.23
7	119.86 ± 4.04	119.46 ± 3.72
8	124.84 ± 4.31	124.10 ± 3.78
9	129.98 ± 4.17	129.35 ± 4.05
10	134.69 ± 4.52	133.84 ± 4.61
11	139.93 ± 4.69	139.59 ± 4.94
12	144.53 ± 4.55	144.87 ± 5.27
13	148.56 ± 4.91	151.19 ± 5.27
14	156.70 ± 6.14	157.55 ± 5.30
15	164.86 ± 6.32	163.91 ± 5.36

TABLE IV: Weight Percentiles of Boys and Girls

Boys							Age (yrs)	Girls						
3rd	10th	25th	50th	75th	90th	97th		3rd	10th	25th	50th	75th	90th	97th
16.72	18.14	19.59	21.00	22.40	23.82	25.73	6	15.56	17.18	18.79	20.68	22.51	24.78	25.71
17.84	19.48	21.15	22.76	24.39	26.03	27.67	7	17.21	18.84	20.46	22.04	23.67	25.52	27.50
19.48	21.32	23.19	24.99	26.87	28.66	30.44	8	18.75	20.57	22.38	23.98	25.98	27.82	29.81
21.45	23.48	25.54	27.54	29.57	31.60	33.63	9	20.29	22.41	24.53	26.43	28.76	30.89	33.75
23.56	25.79	28.05	30.24	32.48	34.70	36.93	10	21.94	24.42	26.88	29.30	31.82	34.33	36.77
25.64	28.08	30.56	32.97	35.41	37.86	40.30	11	23.80	26.62	29.43	32.02	35.06	37.94	40.71
27.50	30.18	32.90	35.56	38.25	40.93	43.62	12	25.10	28.30	31.50	34.70	37.90	41.10	44.65
29.20	32.29	35.20	38.20	41.35	44.35	47.35	13	28.90	32.57	36.24	39.91	43.58	47.25	50.94
33.20	36.93	40.66	44.39	48.32	52.03	56.21	14	34.20	37.93	41.66	45.39	49.12	52.85	56.57
42.10	42.97	46.84	50.71	54.58	60.54	66.15	15	40.20	44.07	47.94	51.81	55.68	59.55	63.36

TABLE V: Height Percentiles of Boys and Girls

Boys							Age (yrs)	Girls						
3rd	10th	25th	50th	75th	90th	97th		3rd	10th	25th	50th	75th	90th	97th
106.7	109.6	112.8	115.9	118.9	122.0	125.1	6	106.3	109.2	112.2	115.1	118.1	121.0	124
111.7	114.5	117.3	120.1	122.8	125.6	128.4	7	112.1	114.6	117.1	119.6	122.1	124.6	127.1
116.2	119.4	122.0	124.8	127.5	130.2	133.0	8	116.7	119.2	121.7	124.2	126.7	129.2	121.6
121.2	124.2	126.9	129.8	132.6	135.5	138.4	9	120.8	123.6	126.3	129.1	131.8	134.5	137.2
125.9	128.9	131.9	134.9	137.9	140.9	143.9	10	125.0	128.0	131.1	134.2	137.2	140.3	143.3
130.6	133.7	136.8	139.9	143.0	146.1	149.2	11	129.6	132.9	136.2	139.6	142.8	146.1	149.4
135.4	138.3	141.5	144.5	147.6	150.6	153.6	12	134.5	137.9	141.4	144.9	148.9	151.9	155.4
138.8	142.0	145.3	148.7	151.8	155.1	158.4	13	140.8	144.2	147.8	151.2	154.7	158.2	161.7
144.5	148.5	152.6	156.9	160.8	164.9	169.0	14	147.1	150.6	154.1	157.5	161.1	164.6	168.1
152.2	156.4	160.7	164.9	169.1	173.3	177.5	15	153.4	156.9	160.5	163.9	167.5	171.1	174.6

Weight and height percentiles for each sex are represented as curves in Figs. 1 and 2. Figures 3 and 4 illustrate comparisons of the 50th percentile with regard to weight and height of children living in Adana, İstanbul, Trabzon, Gemlik and the USA. There is also a comparison of the results obtained by Koksal[8] from Turkey. A statistical comparison could not be made because the numbers of children in the various surveys were not indicated.

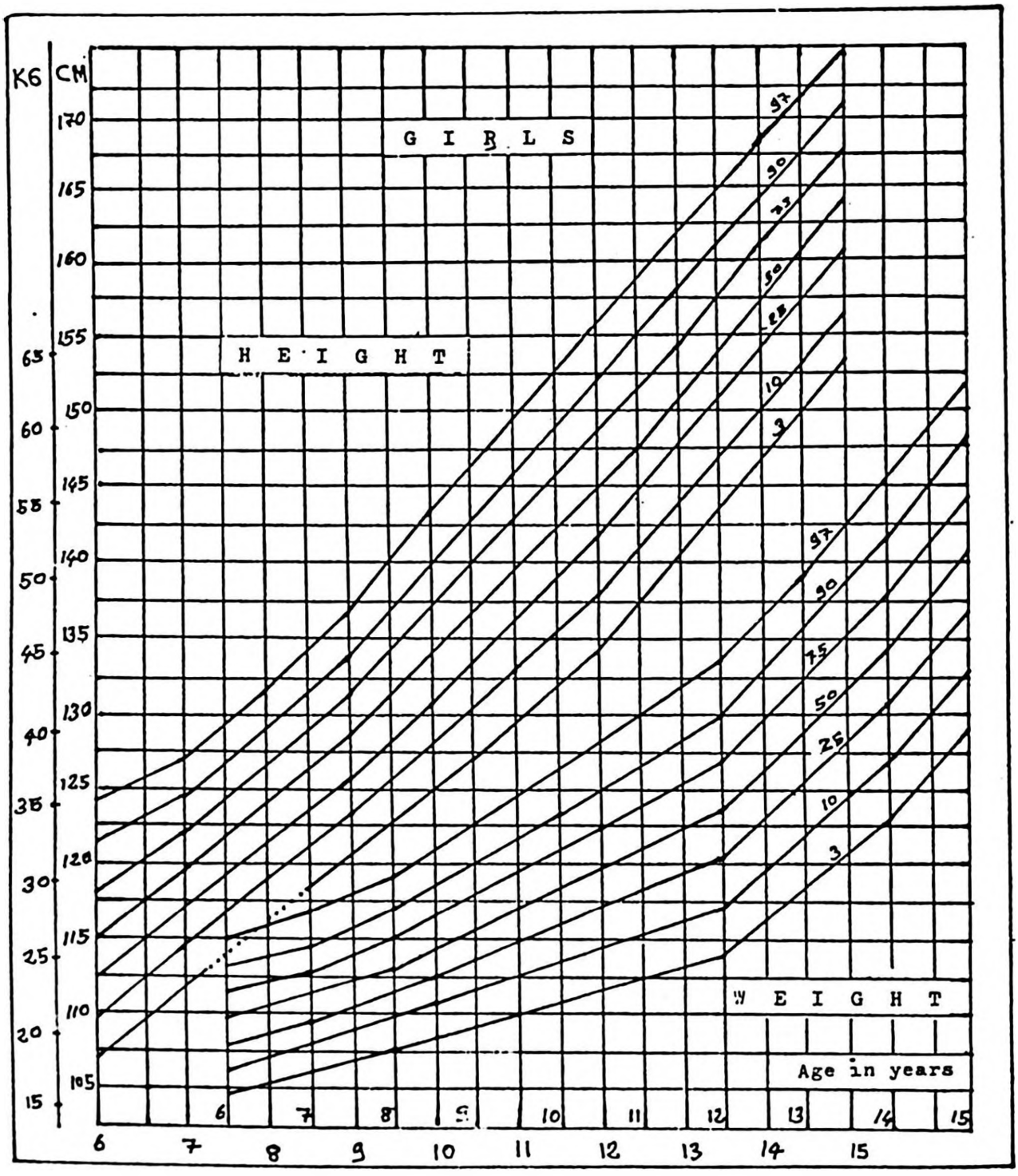

Fig. 1: Height and weight percentiles of boys.

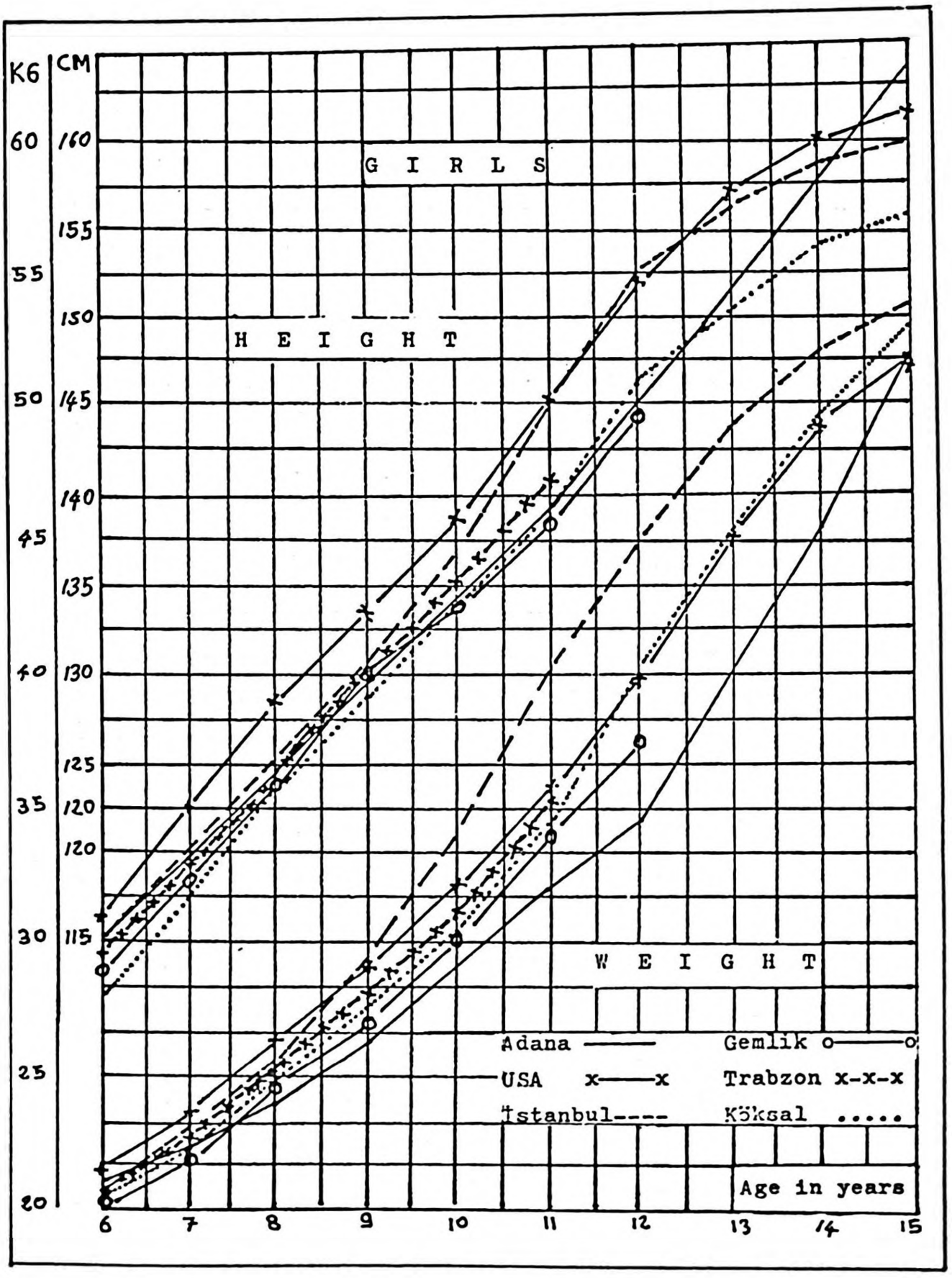

Fig. 2: Height and weight percentiles of girls.

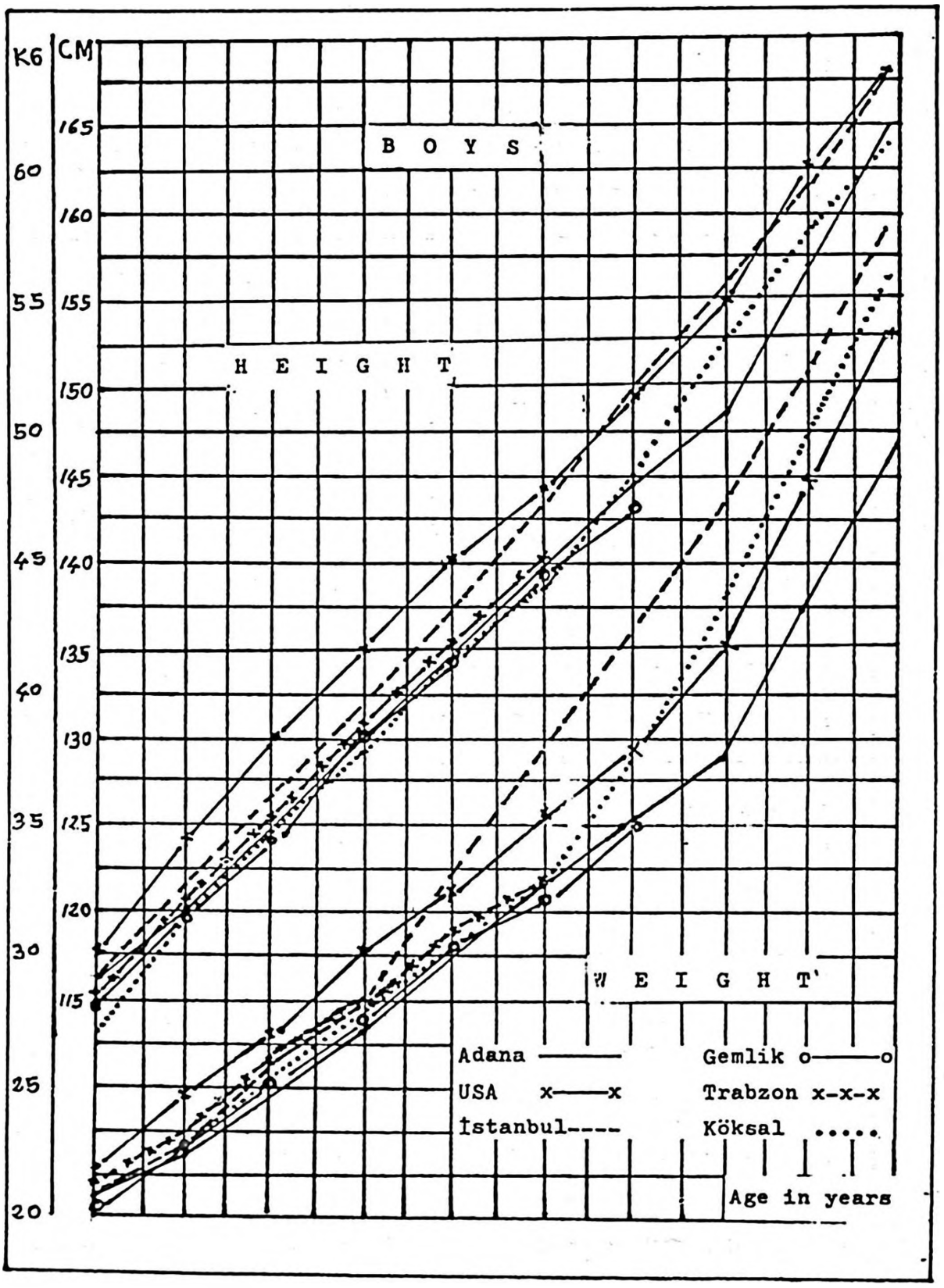

Fig. 3: Comparison of the 50th percentile with regard to weight and height of boys living in Adana with those living in the USA, Istanbul, Gemlik, Trabzon, and Köksal's[8] results.

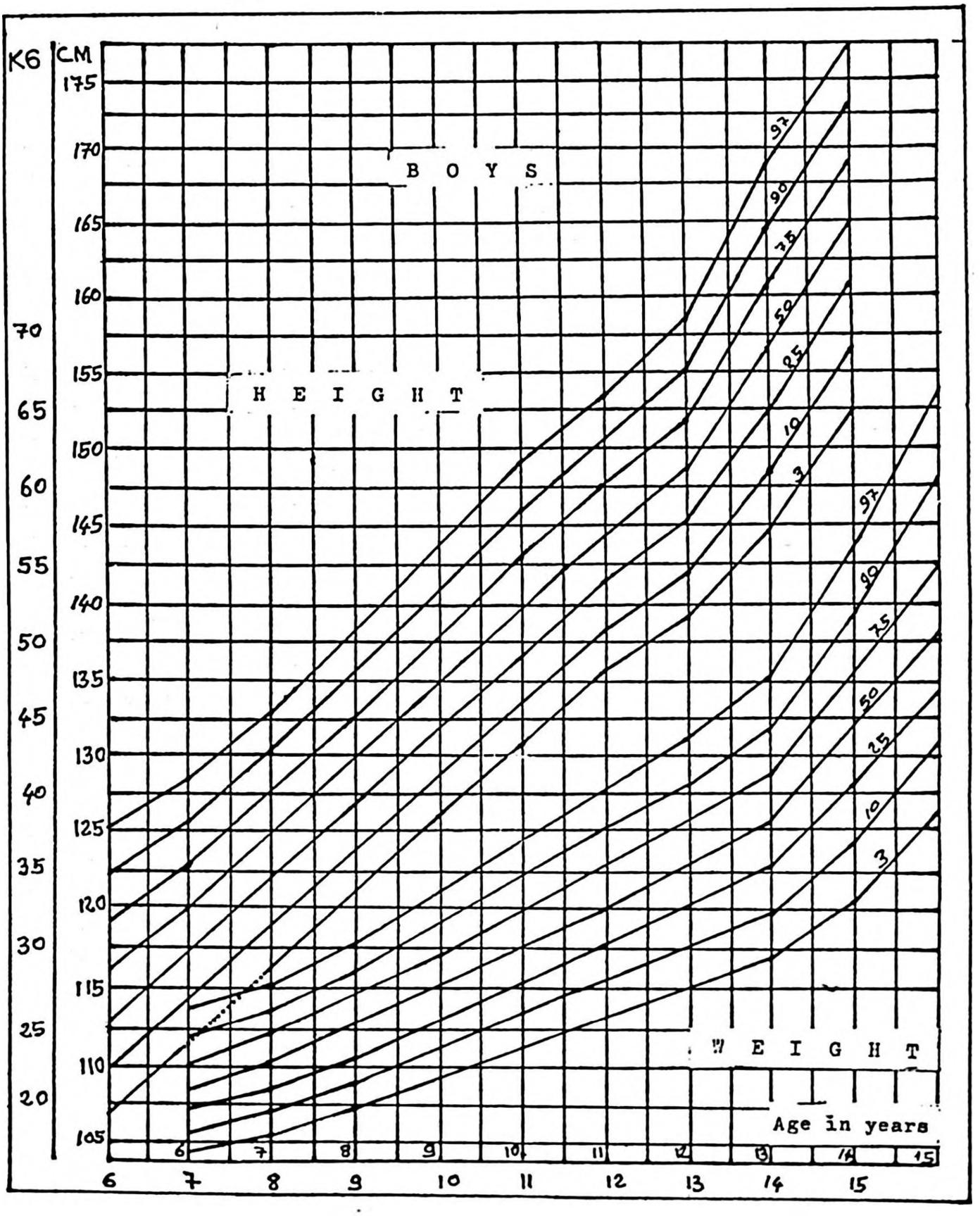

Fig. 4: Comparison of the 50th percentile with regard to height and weight of girls living in Adana with those living in the USA, Istanbul, Gemlik, Trabzon, and Koksal's[8] results.

Discussion

In pediatrics the practice of measuring developmental growth and comparing the measurements with appropriate standards is very valuable[6]. Measurements of physical growth are used in child health care in order to detect abnormalities, reassure parents concerning normality, assess suspected abnormalities of growth and evaluate treatment[9,10]. They also provide concrete and definite criteria regarding the normal growth pattern which is influenced by the interaction of genetic and external factors[11] such as: nutrition, infection, intoxication and other deleterious external influences which are primarily seen in developing countries and can prevent the growth potential of children[11]. Therefore, the use of standards based on measurements taken from children in highly industrialized countries can result in misleading conclusions[1]. In taking into consideration these differences resulting from genetics and external influences, the World Health Organization (WHO) has recommended that every country use its own standards[11,12].

The first important survey of body measurements in the world was carried out by Quatelet in 1835, and several studies followed this[6]. The first significant study in Turkey was conducted by Doğramacı[13], between 1949-1954. This study showed that sex differences along with socioeconomic levels of parents influence the birth weight and height of children. Tanner et al[14,15] studied the effects of socioeconomic levels on growth measurements of children living in urban and rural regions in various European countries and showed that the socioeconomic level of the parents clearly influenced the growth index. Subsequently, several significant studies have been reported which clarify the issue[6,12]. Recently, in order to standardize the studies and obtain reliable values, WHO suggested that the following criteria be used[4,11]: The subjects selected should be well-nourished urban children; for each sex and age-group the sample should consist of at least 200 children; measurements should be taken by experienced personnel using standard equipment; a study should preferably be a cross-sectional survey since it will be used in this manner, and thus, the results obtained will represent the real growth potential of the population and can then be compared to data from other countries.

Our study carried out on a sampling of children and the measurement techniques and equipment used were in compliance with WHO's recommendations. The subjects that we chose were generally well-nourished and their families were of a high socioeconomic level. It has been suggested that universal growth standards be based on measurements of healthy children of a certain locality[7,11]. If this is not accomplished, the values obtained will be lower than the real values and might not represent the real growth potential of that population[1]. Therefore, WHO and the International Committee of Nutrition also recommended that the study

groups be members of families of higher socioeconomic levels living in urban areas[4,11,16]. Our study is in accordance with the afore-mentioned suggestions and it can be considered a reliable standard for the Çukurova Region.

In the comparison of the 50th percentile with regard to weight, the results obtained from the children living in Adana were significantly lower than the children living in İstanbul, Trabzon, and the USA. This relationship is illustrated in Figs. 3 and 4. Similar results were arrived at regarding children living in Gemlik and Adana. Koksal's[8] results represent the average of seven regions in Turkey and when our results were compared with his work, apparent differences were observed which might have been due to regional changes.

When the children's heights were compared, similar results were obtained. The differences in height and weight measurements of the children living in Adana, Istanbul, and the USA were greater in the older age-groups (Figs. 3 and 4). A comparison of the results showed that the growth standards of the children living in the evaluated regions of Turkey were apparently different; there also were differences in the height and weight measurements of the children living in Turkey and the USA.

Considering these results, we can conclude that local growth standards based on local measurements be utilised in evaluating the growth of children in certain regions of Turkey. Therefore, separate growth standards specific to a certain area should be determined and used in the evaluation of the growth of children living in different regions of Turkey. The measurements presented represent only the growth standards of children living in Adana, aged 6-15 years. We hope that our study will contribute to the establishment of standard norms for Turkish children throughout the country as a whole.

Summary

Height and weight measurements of 18,719 healthy children were obtained and the results were compared with those obtained from children living in several regions of Turkey and the USA. The results of these measurements differed significantly. This study demonstrates that local growth standards should be established and used in the evaluation of children.

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