

# Anthropometry of Male and Female Children in Crèches in Turkey

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## ABSTRACT

*This paper presents the results of an anthropometrical survey conducted on male and female children aged 3, 4 and 5 years in Turkey. A set of 18 body dimensions was taken from 154 males and 132 females. It is considered that the 18 parameters are necessary for the design of school furniture, fittings and equipment in order to minimize musculo-skeletal, visual and circulatory problems resulting from badly designed elements. This study identified significant gender differences in a set of 18 anthropometrical measures in this subject group.*

**Keywords:** anthropometry, children, crèches, Turkey

## Introduction

Anthropometrical measurements of the human body have been developed for various reasons since early times of history. Only since the Second World War, however, has such data been developed essentially for design of equipment and workplaces<sup>1</sup>. The aim is to eliminate harmful postures and to minimize the design imposed stresses on the user. At the same time small changes, if made to the required physical dimensions of the workspace can have considerable impact on worker productivity and occupational safety and health<sup>2</sup>. Therefore, the user characteristics and specifically the structural anthropometrics dimensions should be known for design of an effective workstation<sup>3</sup>.

It is necessary to know the body dimensions of the potential user while designing products. This is important for service sectors such as schools, hotels and banks as well as production and manufacturing sectors. Accidents may occur due to incorrect product dimensions that do not meet the human dimensional requirements. Musculoskeletal, visual and circulatory health problems are the expected results of this situation<sup>4</sup>.

Crèches children and teenagers are expected to sit about 30% and 78% of their time during school, respec-

tively<sup>5</sup>. Harper et al.<sup>5</sup> noted the importance of furniture specifically designed for a child's body proportions and recommended different sitting postures for different activities. The anthropometric data of 3, 4 and 5 year old children would be used in the design of tables, chairs, coat hangers, toy/shoe/equipment cupboards, washbasins, mirrors, WC pans, TV tables, and bed/bunks.

It is known that there are serious ergonomic problems in schools in Turkey that can be related to a lack of reliable anthropometrical data and its application<sup>6-8</sup>. The main objective of this research was to determine reliable and accurate structural anthropometrical measurements for male and female children to use in the product design process.

## Methods

### Subjects

Data was obtained from 286 children of normal health and actively attending private and public crèches in Trabzon. A total of 154 males and 132 females were measured. The number of subjects was determined statistically. The crèches sampled were selected randomly

in and around the city of Trabzon. Participation was on a voluntary basis. All crèches involved in the study had a homogeneous structure socially and economically and well reflected the socio-economic make-up of the society. Within each crèches selected, children were chosen randomly<sup>1,4,9</sup>. Measurements included children aged 3, 4 and 5 years attending sixteen different crèches.

*Dimensions measured*

For the purpose of this research, a total of 18 structural anthropometrical dimensions were measured for both males and females: nine of the dimensions were related to the standing position and nine to the sitting position (Table 1, Figure 1 and 2), as mentioned in similar researches<sup>3,10</sup>.

The subject posture and the definitions of each anthropometrical parameter were based on standard pro-

**TABLE 1**  
ANTHROPOMETRICAL CHARACTERISTICS MEASURED  
IN THE STANDING AND SITTING POSITION

Position	
Standing	Sitting
1. Stature	10. Stature
2. Maximum vertical reach	11. Eye height
3. Eye height	12. Elbow height
4. Elbow height	13. Hip breadth
5. Forward elbow reach	14. One calf thickness
6. Forward arm reach	15. Two calf thickness
7. Shoulder breadth	16. Buttock-calf depth
8. Elbow to elbow breadth	17. Buttock-knee depth
9. Waist depth	18. Sitting height

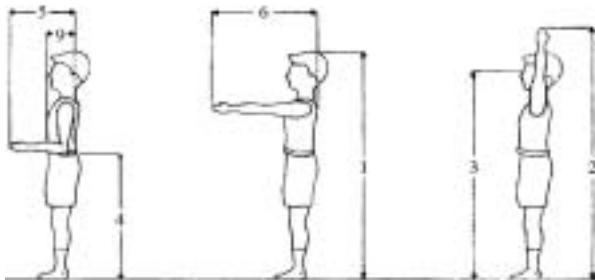


Fig. 1. Anthropometric characteristics measured in the standing position.

cedures<sup>11</sup>. The dimensions measured were all named and numbered according to CEN standard EN 979 »Basic list of definitions of human body measurements for technical design« (identical with ISO standard 7250:1996)<sup>1</sup>.

Measurements were taken from the right side of the body with the subject standing in a relaxed condition<sup>12</sup>. Although it may be argued that the dominant side would be larger than the non-dominant side, initial measurements on either side of the body have let to the conclusion that no statistical difference was present between the two sides. Thus, one-side measurements were used for practical purposes.

*Measuring equipment*

Equipments used for the measurements are as follows: Forward arm reach was measured using a tape measure according to the method of Lohman et al.<sup>13</sup>. Small, slightly modified sliding callipers<sup>14</sup> and a portable chair of adjustable height were also used to measure the sitting dimensions; Height and depth was measured using a portable adjustable tape measure<sup>15</sup>. As shown in figure 3 the principal components of the anthropometer used are aluminum vertical profile and sliding callipers. Modifications were made by adding a screw system and a wide platform (pad) to measure more properties correctly.

*Measuring procedure*

Measurements were taken during the spring of 2002 by two groups of researchers, each having an architect, interior designer, and industrial and mechanical engineer. Measurements were taken on 286 children during the two-month-period. The researchers were trained in anthropometrical techniques and checked for consistency in their procedures. Along with the measurements, general information such as age, sex and name was recorded together with the name of the crèches.

Subjects wore light (indoor) clothes while participating in the study. The subjects were measured in standing and sitting positions<sup>5</sup>. In the sitting position, the knee and hip angles were controlled to be 90°. Subjects who were unable to extend their arms at right angles to their body and those with extensive curvature of the spine were excluded from the measurements<sup>11,16</sup>.

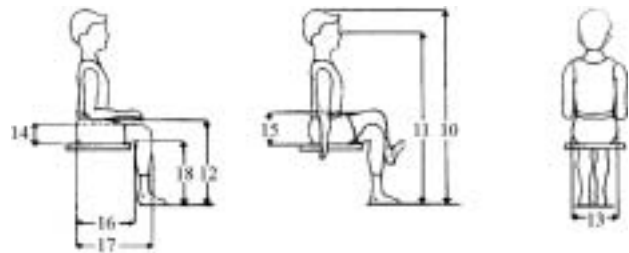


Fig. 2. Anthropometric characteristics measured in the sitting position.

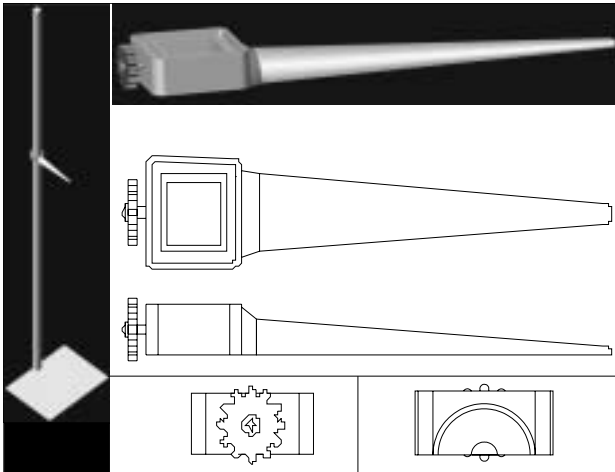


Fig. 3. Appearances of the anthropometer used and its components.

**Statistics**

All the measurements were taken in millimeters, entered into a computer and analyzed using the statistical package for the social sciences<sup>5,15,17,18</sup>.

Prior to any statistical analysis, the Kolmogorov-Smirnov test for normality was performed for all dimensions to ensure that the data represented a normal distribution (Table 2)<sup>1,19</sup>. An *ln* transformation was employed for the data that did not show a normal distri-

bution. None of the data used in this analysis was skewed. Then descriptive statistics such as means, standard deviations and percentiles were calculated separately for all males and all females. At the same time, based on these values, the 1<sup>st</sup>, 5<sup>th</sup>, 50<sup>th</sup>, 95<sup>th</sup> and 99<sup>th</sup> percentiles were calculated.

Statistical comparisons between the mean dimensions of the males and females were also performed (Table 3 and 4) using a series of the Independent student sample *t*-test with equal *n*, and a critical value of 0.05<sup>1,3,10,19,20</sup>. At the same time, Pearson correlation was applied to establish the relationship between the anthropometrical characteristics for each group.

**Results**

Anthropometrical characteristics of male and female students aged 3, 4 and 5 were measured separately for the standing and sitting positions (Table 1). Table 1 comprises two groups of characteristics; static (no 1, 3, 4, 7–13, 16–18) and dynamic (no 2, 5, 6, 14, 15).

In order to define changes in the analyzed characteristics by sex and age groups of the subjects, the material obtained was divided into three age classes (3, 4 and 5) separately for girls and boys.

Parametric data should resemble a normal distribution for using the parametric statistics techniques<sup>21</sup>. Thus, first the data set was checked for normality. The Kolmogorov-Smirnov test indicated that the data re-

TABLE 2  
THE RESULTS OF KOLMOGOROV-SMIRNOV TEST

Variable	Groups	K. S. Z	Sig. (2-tail)	Variable	Groups	K. S. Z	Sig. (2-tail)
Age	1	4.343	0.000	Sitting Stature	1	1.076	0.197
	2	4.534	0.000		2	0.462	0.983
Stature	1	0.715	0.686	Eye Height	1	0.454	0.986
	2	0.895	0.400		2	0.454	0.986
Max. Vertical Reach	1	1.128	0.564	Elbow Height	1	0.719	0.679
	2	0.773	0.589		2	0.755	0.619
Eye Height	1	0.678	0.747	Hip Breadth	1	0.858	0.454
	2	0.858	0.454		2	0.500	0.964
Elbow Height	1	0.475	0.978	One Calf Thickness	1	1.320	0.061
	2	0.571	0.901		2	0.796	0.550
Forward Elbow Reach	1	0.555	0.918	Two Calf Thickness	1	1.017	0.252
	2	1.001	0.269		2	1.092	0.184
Forward Arm Reach	1	0.636	0.813	Buttock-calf Depth	1	0.932	0.350
	2	0.489	0.965		2	0.859	0.451
Shoulder Breadth	1	0.946	0.333	Buttock-knee Depth	1	0.830	0.496
	2	1.069	0.234		2	1.053	0.217
Elbow to Elbow Breadth	1	1.000	0.270	Sitting Height	1	0.998	0.272
	2	0.717	0.684		2	1.219	0.103
Waist Depth	1	1.611	0.012	Waist Depth Trans.	1	1.369	0.049
	2	1.071	0.201		2	0.844	0.474

Group 1: Female  
Group 2: Male

**TABLE 3**  
PERCENTILES – FEMALES AND MALES, TOTAL POPULATION (CM)

Dimension	Group	Mean	St. Dev.	1 <sup>st</sup>	5 <sup>th</sup>	50 <sup>th</sup>	95 <sup>th</sup>	99 <sup>th</sup>
Stature	1	103.73	6.35	89.09	93.05	103.70	113.64	117.27
	2	104.13	9.86	88.47	92.28	105.25	114.05	121.68
Max. Vertical Reach	1	124.91	9.14	103.05	110.24	124.55	139.04	145.05
	2	125.76	9.42	102.36	108.63	126.50	139.15	152.89
Eye Height	1	92.84	6.26	78.76	81.49	92.55	103.41	106.67
	2	93.30	8.49	77.64	80.68	94.10	103.63	109.62
Elbow Height	1	60.01	4.34	49.26	52.89	60.10	67.30	69.94
	2	60.16	4.72	48.23	52.10	60.10	67.88	72.33
Forward Elbow Reach	1	28.60	2.17	22.20	24.83	28.60	32.24	33.94
	2	29.31	2.66	23.71	25.33	29.15	33.70	40.22
Forward Arm Reach	1	50.28	4.40	38.35	43.27	50.35	57.47	58.90
	2	51.09	4.68	42.26	43.70	51.20	57.53	62.75
Shoulder Breadth	1	26.06	1.89	22.47	23.27	26.00	29.20	31.83
	2	26.22	1.80	22.27	23.48	26.25	28.93	29.94
Elbow to Elbow Breadth	1	28.84	20.99	22.70	23.57	26.80	31.41	33.30
	2	27.68	2.19	23.61	24.43	27.50	31.73	32.60
Waist Depth	1	13.37	1.42	10.40	11.40	13.20	16.24	17.27
	2	13.62	1.45	10.98	11.50	13.40	16.63	17.34
Sitting Stature	1	77.46	6.80	38.74	68.83	78.10	86.70	88.87
	2	78.15	7.68	65.36	70.23	78.35	86.65	94.32
Eye Height	1	67.15	5.07	52.52	59.53	67.10	76.47	78.07
	2	67.17	4.66	54.99	59.20	67.25	74.10	79.19
Elbow Height	1	34.75	3.83	26.90	28.89	34.45	41.60	47.87
	2	34.37	3.32	26.50	29.10	34.05	40.95	42.44
Hip Breadth	1	22.27	1.82	16.93	19.50	22.40	25.37	26.84
	2	22.67	2.05	16.99	19.68	22.65	26.25	28.20
One Calf Thickness	1	7.70	1.24	5.67	6.00	7.50	10.14	10.93
	2	7.56	1.18	4.96	5.78	7.50	9.53	10.48
Two Calf Thickness	1	15.35	2.12	10.20	11.97	15.25	19.54	20.97
	2	16.00	2.32	10.68	12.38	15.55	19.83	22.92
Buttock-calf Depth	1	28.04	2.24	21.93	23.79	28.05	31.34	34.54
	2	27.27	2.19	22.15	23.78	27.10	31.20	33.73
Buttock-knee Depth	1	33.99	2.83	26.06	29.47	34.05	38.67	40.40
	2	33.59	3.32	21.60	29.40	33.40	38.10	46.39
Sitting Height	1	23.73	2.43	18.80	19.39	23.55	27.70	29.00
	2	23.52	2.17	18.70	20.20	23.35	27.60	28.95

Group 1: Female  
Group 2: Male

sembled a normal distribution except for one characteristic of female group, waist depth. Thus an *ln* transformation on this variable was conducted. Then descriptive statistics (arithmetic mean, standard deviation, 1<sup>st</sup>, 5<sup>th</sup>, 50<sup>th</sup>, 95<sup>th</sup> and 99<sup>th</sup> percentiles) were calculated for each characteristic for the pooled male and female populations (Table 3).

As seen in Table 3, there were no significant differences in arithmetic means of the analyzed characteris-

tics between the male and female groups. Although statistically insignificant, the largest difference in arithmetic means of analyzed characteristics between two groups was observed in maximal vertical reach and forward arm reach.

Independent student sample *t*-tests were applied to define the differences among the mean values for the two groups given in the Table 4. According to the test, there were significant differences in forward elbow

**TABLE 4**  
THE VALUES OF THE t-TEST BETWEEN THE FEMALE AND MALE GROUPS

Dimension	Levene's Test for Equality of Variances		t-test for Equality of Means					
	F	Sig.	t	df	Sig. (2-tail)	Std. Er. Differ.	95% Confidence	
							Lower	Upper
Stature	0.371	0.543	-1.382	284	0.168	0.755	-2.529	0.442
Max Vertical Reach	0.014	0.907	-0.772	284	0.441	1.102	-3.020	1.318
Eye Height	0.102	0.750	-1.120	284	0.264	0.756	-2.339	0.642
Elbow Height	0.323	0.570	-0.277	284	0.782	0.540	-1.211	0.912
Forward Elbow Reach	1.661	0.198	-2.464	284	0.014	0.290	-1.286	-0.143
Forward Arm Reach	1.004	0.317	-1.817	284	0.070	0.509	-1.930	7.702
Shoulder Breadth	0.547	0.460	-0.717	284	0.474	0.219	-0.588	0.274
Elbow-to-elbow Breadth	0.933	0.335	-2.530	284	0.012	0.259	-1.164	-0.145
Waist Depth. Trans	0.127	0.722	-1.513	284	0.131	1.203	-4.002	5.602
Sitting Stature	1.038	0.309	-1.680	284	0.094	0.708	-2.582	0.204
Eye Height	0.852	0.357	-0.032	284	0.975	0.576	-1.151	1.114
Elbow Height	2.482	0.116	0.912	284	0.363	0.423	-0.447	1.218
Hip Breadth	0.631	0.428	-1.771	284	0.078	0.231	-0.865	4.559
One Calf Thickness	0.167	0.683	0.956	284	0.340	0.144	-0.146	0.420
Two Calf Thickness	2.102	0.148	-2.447	284	0.015	0.264	-1.167	-0.126
Buttock-calf Depth	0.016	0.898	2.917	284	0.004	0.263	0.249	1.282
Buttock-knee Depth	0.118	0.731	1.089	284	0.277	0.368	-0.324	1.125
Sitting Height	2.551	0.111	0.736	284	0.462	0.272	-0.335	0.736

reach, elbow-to-elbow breadth, two-calf thickness and buttock-calf depth. On the other hand, there were no significant differences among the other characteristics of the two groups.

According to the correlation tables of males and females, the significant level is very small (less than 0.05), so the correlation is significant and the variables are linearly related. As can be seen from Table 5, there are positive and significant relationships between stature and maximal vertical reach ( $r=0.907$ ,  $p<0.01$ ), eye height ( $r=0.974$ ,  $p<0.01$ ), elbow height ( $r=0.927$ ,  $p<0.01$ ), forward arm reach ( $r=0.806$ ,  $p<0.01$ ), sitting eye height ( $r=0.858$ ,  $p<0.01$ ), buttock-knee depth ( $r=0.810$ ,  $p<0.01$ ). Similar positive and significant linkages were not found between some variables such as the relationship between sitting height and waist depth trans. ( $r=0.057$ ,  $p>0.05$ ), two-calf thickness ( $r=0.107$ ,  $p>0.05$ ).

As can be seen from Table 6, there are positive and significant relationships between stature and maximal vertical reach ( $r=0.961$ ,  $p<0.01$ ), eye height ( $r=0.900$ ,  $p<0.01$ ), elbow height ( $r=0.899$ ,  $p<0.01$ ), sitting stature ( $r=0.837$ ,  $p<0.01$ ), sitting eye height ( $r=0.822$ ,  $p<0.01$ ). No relationships were found between waist depth trans. and buttock-calf depth ( $r=0.014$ ,  $p>0.05$ ) and sitting height ( $r=0.065$ ,  $p>0.05$ ).

## Discussion

This study investigated the anthropometrical characteristics of the crèche children and is the first study

that has been conducted in Turkey. It is accepted that the continuity of these kinds of studies are necessary for the researches as well as the producers/designers of equipment.

It is known that there are a lot of ergonomic problems in the schools in Turkey and this could lead to increased health problems. Thus, the set of anthropometrical data obtained should be used for the design or adaptation of interior design and furnishing as well as the design of places for variable actions such as sleeping, studying, playing, eating and etc.

By increasing the number of anthropometrical characteristics taken from children, the data would be used in industrial and social life such as furnishing, textile products and school. Further work is recommended in identifying the anthropometrical differences between children living in different regions of Turkey, and the relative changes in anthropometrical dimensions as the child ages. Repeating cross-sectional studies such as this will also allow an understanding of the influence of secular trends in Turkish children. Finally, because of changes in measures of the human body, this kind of study should be repeated periodically.

## Acknowledgements

We thank all of the children who participated in this study. In addition, we thank all managers and employees of the schools for their support in this research.

**TABLE 5**  
PEARSON CORRELATION RESULTS OF FEMALE SUBJECTS

Dimension	Age	Stature	Max. Vertical Reach	Eye Height	Elbow Height	Elbow Extend	Forward Arm Reach	Shoulder Breadth	Elbow to Elbow Breadth	Waist Depth. Trans	Sitting Stature	Eye Height	Elbow Height	Hip Breadth	One Calf Thickness	Two Calf Thickness	Buttock-calf Depth	Buttock-knee Depth	
Stature	0.579**	1.000																	
Max. Vertical Reach	0.567**	0.907**	1.000																
Eye Height	0.580**	0.974**	0.907**	1.000															
Elbow Height	0.540**	0.927**	0.842**	0.918*	1.000														
Forward Elbow Reach	0.433**	0.646**	0.624**	0.614*	0.549**	1.000													
Forward Arm Reach	0.546**	0.806**	0.784**	0.798*	0.724**	0.640**	1.000												
Shoulder Breadth	0.351**	0.597**	0.566**	0.549*	0.588**	0.445**	0.439**	1.000											
Elbow to Elbow Breadth	0.347**	0.482**	0.454**	0.443*	0.497**	0.400**	0.333**	0.750**	1.000										
Waist Depth Trans.	0.202*	0.316**	0.285**	0.272**	0.326**	0.321**	0.185*	0.589**	0.673**	1.000									
Sitting Stature	0.269**	0.671**	0.591**	0.642*	0.641**	0.445**	0.511**	0.498**	0.400**	0.248**	1.000								
Eye Height	0.451**	0.858**	0.807**	0.838**	0.807**	0.585**	0.730**	0.571**	0.431**	0.300**	0.721**	1.000							
Elbow Height	0.391**	0.621**	0.613**	0.623*	0.642**	0.373**	0.527**	0.425**	0.352**	0.191*	0.601**	0.798**	1.000						
Hip Breadth	0.155	0.511**	0.446**	0.463*	0.527**	0.323**	0.343**	0.591**	0.544**	0.509**	0.416**	0.490**	0.299**	1.000					
One Calf Thickness	0.165	0.393**	0.366**	0.361*	0.409*	0.347**	0.317**	0.605**	0.642**	0.613**	0.398**	0.436**	0.373**	0.466**	1.000				
Two Calf Thickness	0.215*	0.466**	0.397**	0.420*	0.478**	0.337**	0.378**	0.530**	0.530**	0.391**	0.301**	0.408**	0.272**	0.473**	0.478**	1.000			
Buttock-calf Depth	0.460**	0.608**	0.561**	0.568*	0.466**	0.501**	0.529**	0.242**	0.186*	0.180*	0.360**	0.473**	0.285**	0.209*	0.126	0.268**	1.000		
Buttock-knee Depth	0.575**	0.810**	0.724**	0.783**	0.716**	0.567**	0.635**	0.539**	0.464**	0.290**	0.512**	0.634**	0.399**	0.465**	0.329**	0.486**	0.672**	1.000	
Sitting Height	0.368**	0.601**	0.595**	0.607*	0.575	0.366**	0.604**	0.275**	0.236**	0.057	0.463**	0.677**	0.674**	0.176*	0.357**	0.107	0.337**	0.448**	

\* Correlation is significant at the 0.05 level (2-tailed), \*\* Correlation is significant at the 0.01 level (2-tailed)

**TABLE 6**  
PEARSON CORRELATION RESULTS OF MALE SUBJECTS

Dimension	Age	Stature	Max. Vertical Reach	Eye Height	Elbow Height	Forward Elbow Reach	Forward Arm Reach	Shoulder Breadth	Elbow to Elbow Breadth	Waist Depth. Trans.	Sitting Stature	Eye Height	Elbow Height	Hip Breadth	One Calf Thickness	Two Calf Thickness	Buttock-calf Depth	Buttock-knee Depth	
Stature	0.597**	1.000																	
Max. Vertical Reach	0.557**	0.961**	1.000																
Eye Height	0.591**	0.960**	0.939**	1.000															
Elbow Height	0.534**	0.899**	0.887**	0.891**	1.000														
Forward Elbow Reach	0.263**	0.554**	0.522**	0.515**	0.528**	1.000													
Forward Arm Reach	0.424**	0.728**	0.736**	0.704**	0.687**	0.427**	1.000												
Shoulder Breadth	0.360**	0.659**	0.641**	0.665**	0.606**	0.348**	0.508**	1.000											
Elbow to Elbow Breadth	0.299**	0.478**	0.425**	0.474**	0.461**	0.252**	0.357**	0.737**	1.000										
Waist Depth Trans.	0.141	0.263**	0.204*	0.243**	0.273**	0.205*	0.124	0.502**	0.644**	1.000									
Sitting Stature	0.418**	0.837**	0.798**	0.779**	0.712**	0.472**	0.570**	0.555**	0.428**	0.242**	1.000								
Eye Height	0.431**	0.822**	0.791**	0.765**	0.745**	0.436**	0.588**	0.523**	0.428**	0.261**	0.891**	1.000							
Elbow Height	0.288**	0.527**	0.508**	0.494**	0.479**	0.222**	0.379**	0.376**	0.399**	0.234**	0.723**	0.748**	1.000						
Hip Breadth	0.325**	0.539**	0.554**	0.534**	0.487	0.436**	0.504**	0.481**	0.489**	0.283**	0.454**	0.469**	0.346**	1.000					
One Calf Thickness	0.212*	0.359**	0.311**	0.320**	0.396**	0.197*	0.238**	0.444**	0.551**	0.555**	0.218**	0.251**	0.198**	0.267**	1.000				
Two Calf Thickness	0.267**	0.385**	0.347**	0.385**	0.386**	0.226**	0.224**	0.453**	0.422**	0.305**	0.267**	0.245**	0.090	0.199*	0.440**	1.000			
Buttock-calf Depth	0.282**	0.539**	0.533**	0.496**	0.474**	0.341**	0.443**	0.281**	0.158	0.014	0.416**	0.401**	0.147	0.275**	-0.049	0.221**	1.000		
Buttock-knee Depth	0.337**	0.582**	0.565**	0.577**	0.564**	0.317**	0.468**	0.579**	0.448**	0.283**	0.444**	0.391**	0.268**	0.255**	0.390**	0.357**	0.288**	1.000	
Sitting Height	0.387**	0.615**	0.629**	0.562**	0.555**	0.341**	0.458**	0.273**	0.214**	0.065	0.693**	0.722**	0.681**	0.325**	0.110	-0.108	0.375**	0.279**	

\* Correlation is significant at the 0.05 level (2-tailed), \*\* Correlation is significant at the 0.01 level (2-tailed)

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## ANTROPOMETRIJA DJECE MUŠKOG I ŽENSKOG SPOLA U JASLICAMA U TURSKOJ

### SAŽETAK

U ovom radu su prikazani rezultati antropometrijske studije koja je provedena na dječacima i djevojčicama u dobi od 3, 4 i 5 godina u Turskoj. Mjeren je uzorak od 18 parametara na 154 dječaka i 132 djevojčice. Smatra se da je tih 18 parametara dovoljno za dizajniranje namještaja u školama i opreme, u svrhu smanjivanja mišićno-koštanih, vidnih i cirkulatornih problema koji nastaju zbog neprilagođenosti raznih elemenata. Ova studija je identificirala značajne razlike po spolu na uzorku od 18 antropometrijskih mjera u proučavanoj grupi.