ASSESSMENT OF AGE, SEX AND STATURE BY SOME ANTHROPOMETRIC MEASUREMENTS IN A SAMPLE OF EGYPTIAN RURAL CHILDREN

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ABSTRACT

Introduction: The stature of an individual is an inherent characteristic; it is considered to be an important assessment in the identification of unknown human remains. ***Objectives:*** The purpose of the present study was to determine the statistical correlations between age, sex and stature and anthropometric measurements of the head, upper and lower extremities and body mass index (BMI) in a sample of ruralEgyptianchildren of school age (6-<13 years).***Methodology:***The present study was a cross-sectional study that was conducted on 350 healthy school childrenaged 6-13 years who were randomly selected from primary schools inBehera governorate. Assessment of age, sex and stature was performed through sociodemographic data, and anthropometric measures.***Results***: In this study among various anthropometric parameters arm span and lower limb length were shown to have the strongest correlation with stature, but leg length was highly significantlycorrelated with age(9 years), arm length (6 & 11) years, head circumference (7 & 8) years, and head length (10 years). **Conclusion:**The means of most anthropometric measurements were greater in girls than in boys. Several regression equations were constructed to estimate the age, sex and stature of the children.

Keywords: age, sex, stature, anthropometry, rural children, Egypt

INTRODUCTION

The method of quantitatively expressing the differences that various people or features display is called anthropometry. It offers scientific procedures and estimation methodologies for a range of measurements and observations of both living things and the human skeleton. One of the many data points for identification is stature. It is a biological development parameter that is influenced by both environmental and genetic variables. **(Vinitha et al., 2015).**

Stature sheds light on a variety of human characteristics, such as heredity, health, and nutrition. An individual's stature is an innate quality, and determining its approximate value is thought to be crucial when identifying unidentified human remains. **(Krishan and sharma., 2007).**

Since the end of the 19th century, measurements of various body parts and bones, particularly the upper and lower extremities, have been used to estimate stature. Karl Pearson developed a mathematical method of correlation calculation for stature prediction via measurements of long bones. He proposed height as a measure of individual identity. **(Banik et al., 2012).**

There are few studies on the assessment of stature via percutaneous measurement of the humerus or upper arm length (UAL), and the majority of those studies have been conducted in adults. **(Salles et al., 2009).**

This study aimed to determine the statistical link between age, sex, and stature to anthropometric measurements of the head, upper and lower extremities and body mass index (BMI) in a sample of Egyptian school-aged rural children (aged 6->13 years).

METHODS

A total of 350 healthy schoolchildren aged 6 to over 13 years were chosen from several primary and secondary schools in the rural governorate of the "Behera governorate" for this cross-sectional study. El Shaheed Mohammed Abd El Latef Shehata Primary School, El Maamoon Primary School, and Abd Allah Lashine Secondary School were chosen as two mixed-gender primary schools and one mixed-gender secondary school. The students were split into two groups: one for boys (175) and another for girls (175). Depending on their age, they were divided into seven groups: (6–7), (7–8), (8–9), (9–10), (10–11), (11–12), and (12–13) years.

Each group of 50 kids was further split into 2 subgroups: 25 males and 25 females. The test was conducted in the morning and afternoon between October and December 2017.

The children, parents, and headmasters of the schools provided their consent after the objectives of the measurements and processes were explained. The right side was used to take the measurements. Anthropometric measurements of their head and upper and lower extremities, as well as their chronological age, sex, and stature, were obtained. Both the headmaster of the schools and the Ministry of Education gave written approval “consent”. The design of the study was authorized by the Kasr alainy Faculty of Medicine Research Ethics Committee.

A) Inclusion criteria:

These children should fulfil the following criteria for choice:

1- Age 6-13 years (from birthday to the day of data collection).

2- Both sexes (male and female)

3- Egyptian children (nationality and origin).

4- Physically and mentally healthy children.

B) Exclusion criteria:

1- Children younger than 6 years or older than 13 years.

2- Non-Egyptian children.

3- Overweight or lower weight children.

4- Children with systemic or chronic disease.

5- Children with any deformity or abnormal gait.

6- Children with a definite history of fracture, injury and/or orthopedic surgery

Methods details:

The following data were collected from each child via data collection forms.

1- Sociodemographic data

***Birthday**: from their personal files in school records, parents and subjects themselves.

* **Age:** subjects above 6 years and below 13 years old. Age was calculated in (decimal) years up to the day of the measurement.

2 – Anthropometric measurements:

- **The secca weight scale** was used to measure **body weight (kg).** The participants were told to stand over the scale wearing only loose clothing and bare feet, with their weights recorded to the closest 0.01 kilogram.

- **Standing height:** The subjects stood barefoot on the **anthropometer platform** and pressed their heels, buttocks, and upper backs against the device's upright posture, with relaxed shoulders and supportive feet. The horizontal plane of Frankfurt contained the head. The bony orbit's inferior margin, or cheekbone, was parallel to the external auditory meatus's (ear canal's) top. The firm was in contact with the skull vertex, and then the number was noted down, roughly to the nearest 0.1 cm. **Fig (1) Navid et al. (2014).**

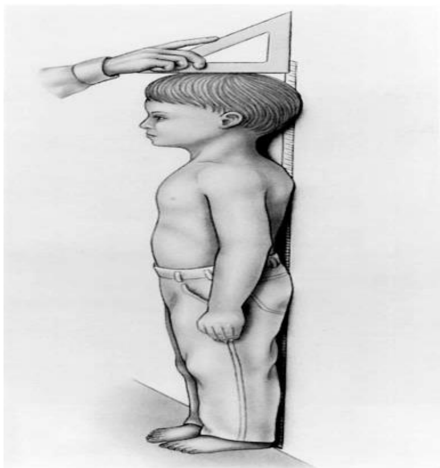

Figure (1): Growth measurements: height of a child **(Soliman et al., 2022)**

- With the aid of a **portable Holtain anthropometer**, the **sitting height** was determined. The child was seated at a desk with their legs hanging loosely and their knees bent at nine hundred degrees and fixed to the edge of the surface. The youngster was sitting straight, facing the vertical backboard of the anthropometer with her or his back to it. The wrists and arms were at ease, with the palms facing medially, and the shoulders were in their natural sloping forward position. The anthropometer rod should be in place when the reading is taken. The final measurement is the average of three measurements. The measurement of sitting height was made with an accuracy of 0.1 cm. **(Haas, 1977).**

- **Maximum head (antroposterior) length (MHL):** The separation between the opisthocranion, the most protruding part of the occiput, and the glabella, the most noticeable point between the eyebrows on the frontal bone and above the root of the nose. Using a sliding calliper, the measurement was made in centimetres. **Fig (2a)(Ukoha et al., 2015).**

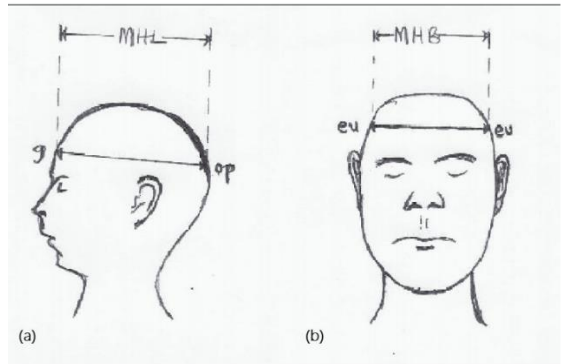

Fig.2a: Landmarks on the head for measuring maximum head length. (MHL = maximum head length; g = glabella; op = opisthocranion). **2 (b):** Landmarks on the head for measuring maximum head breadth. (MHB = maximum head breadth; eu = euryon) (**Ukoha et al., 2015).**

- **The maximum head breadth (MHB)** is the separation between the two euryas, which are the parietal bones' most lateral points. The subject's head was motionless, and they were either seated or standing (Fig 2b). It was also measured with a sliding calliper (in centimeters). **(Ukoha et al., 2015).**

- **Head Circumference (HC):** To measure the circumference of the head, plastic tape was wrapped around the eyebrows, over the most posterior protuberance of the occiput, and around the head overall. **(Jae-Min Kim et al., 2008).**

- **Arm Span (AS):** The measurement was made at shoulder height, parallel to the ground, at an angle of one hundred eighty degrees, between the middle fingertips of the left and right hands. With their heels, buttocks, and upper backs supported by the wall, the measurement was taken on a level concrete floor, barefoot with a steel tape that was calibrated to the closest 0.1 centimeter. **(Bjelica et al., 2012).**

- The distance between the olecranon process and the acromion end of the clavicle is known as the **upper arm length (UAL)**. A sliding calliper was used to measure this parameter in standing individuals in the flex position of their arms **(Vallois, 1965).**

- The **forearm length (FAL)** is the distance between the point midway between the radius and ulnar tuberosities and the tip of the olecranon **(Vaghefi et al., 2014)**, and a sliding calliper is used to measure this distance.

- **Lower Limb Length (LLL):** The subject's sitting height was subtracted from their height to obtain their lower limb length (LLL). **(Kanchan et al., 2015)**

- **Leg length (LL):** The test leg is placed on the opposing knee while the participant is seated, with the medial aspect of the tibia facing upwards. The measurement is made from the knee joint's medial articulation to the most distal point of the medial malleolus. **(Ahmad et al., 2014).**

STATISTICAL METHODS:

The data were entered and coded via SPSS version 24, a statistical software. For quantitative variables, the mean and standard deviation were used to summarize the data; for categorical variables, the frequencies (number of cases) and relative frequencies (percentages) were used. The unpaired t test was used to compare the groups **(Chan, 2003a).** We used the chi square (2) test to compare categorical data. When the anticipated frequency was less than five, an exact test was used instead **(Chan, 2003b).** The Pearson correlation coefficient was used to determine correlations between quantitative variables **(Chan, 2003c).** To identify the factors influencing age and stature, linear regression was used **(Chan, 2004).** Examining the equality of variables between males and females was the first step in the discriminant analysis process. The discriminating function was ascertained by using stepwise statistics to identify the significant predictors. The group centroids, or group means, were then computed; these serve as the thresholds for gender discrimination. The discriminate function was used to classify the percentage of correctly identified cases **(Chan, 2005).** The threshold of 0.05 for a P value was deemed statistically significant.

RESULTS

This cross-sectional study was carried out on 350 healthy rural school children aged 6 to less than 13 years who were chosen from various primary schools in Behera (rural governorate, Egypt). The results of the study are presented below.

Table 1 shows the mean values of the anthropometric measurements from 6- to 9-year-old boys and girls. The mean age of the children was 6.46 years for girls and 6.52 years for boys. A highly significant difference (P <0.001) in head breadth was detected, which was greater in boys. The mean of all measurements was greater in boys than in girls, except for arm length and leg length, which were greater in girls.

The mean age of the 7-year-old boys and girls was 7.33 years, whereas the mean age of the females was 7.36 years. A slightly significant difference was detected for head length, which was greater in boys.

In 8-year-old boys and girls, children were included. For males and girls, the mean ages were 8.48 and 8.38 years, respectively. A slightly significant difference was found (P <0.05) in BMI, which was greater in girls. However, girls presented a greater mean across all the metrics than boys did. With the exception of forearm length, lower limb length and head breadth, which were greater in boys. For 9-year-old boys and girls, the mean ages were 9.34 and 9.38 years, respectively. A moderately significant difference (P <0.01) in BMI was detected, which was greater in girls, and a slightly significant difference (P <0.05) in forearm length was detected, which was higher in boys. However, boys showed a rising mean across all the metrics than girls did. With the exception of BMI and leg length, which were greater in girls.

For both boys and girls between the ages of 6 and 9 years, the mean arm span was less than the height.

Table (1): The comparison of anthropometric measures between 6-9 years' boys and girls.

	6 years (n= 50)		**7 years (n= 50)**		**8 years(n= 50)**		**9 years(n= 50)**	
	Boys Mean ± SD	**Girls Mean ± SD**	**Boys Mean ± SD**	**Girls Mean ± SD**	**Boys Mean ± SD**	**Girls Mean ± SD**	**Boys Mean ± SD**	**Girls Mean ± SD**
Age	6.52 ± .30	6.46 ± .31	7.33 ±.29	7.36±.27	8.48 ±.29	8.38±.26	9.34 ±.29	9.38 ±.31
Height	123.20 ± 4.91	121.32 ± 4.09	126.96 ±5.22	124.96±5.95	131.60 ±5.25	131.88±4.99	136.76 ±3.70	135.68 ±5.74
BMI	15.13 ± 2.83	15.04 ±1.77	15.15 ±1.96	15.19±1.57	15.19 ±1.57	16.37±2.47	16.01 ±1.67	18.17 ±3.20
arm span	120.12 ± 6.22	118.88 ± 3.99	123.76 ±5.89	121.68±6.04	128.24 ±6.38	129.12±5.88	134.20 ±4.57	131.96 ±7.25
arm length	24.06 ± 1.23	24.20 ± .94	25.18 ±1.66	24.12±2.66	26.06 ±1.51	26.46±1.37	27.57 ±.99	27.46 ±1.39
forearm length	17.96 ± 1.14	17.69 ± .85	18.50 ±1.27	17.97±1.09	19.47 ±1.00	19.38±1.02	20.58 ±.95	19.86 ±1.19
lower limb length	59.72 ± 3.31	58.52 ± 2.50	62.00 ±2.69	60.40±3.51	64.48 ±3.69	64.36±3.58	67.40 ±3.30	66.20 ±3.74
leg length	25.84 ± 1.49	25.92 ± 1.44	27.28 ±1.67	27.04±1.86	28.68 ±1.73	28.88±1.51	30.48 ±1.61	30.76 ±1.76
head length	16.68 ± .75	16.18 ± .42	16.76 ±.58	16.43±.60	16.76 ±.69	16.76±.69	16.92 ±.69	16.78 ±.56
head breadth	12.89 ± .57	12.30 ± .56	13.08 ±1.38	12.60±.68	12.80 ±.60	12.72±.55	12.99 ±.50	12.99 ±.53
head circumference	50.92 ± 1.80	49.84 ± 1.14	51.12 ±1.13	50.44±1.29	51.24 ±1.74	51.80±1.26	51.92 ±1.47	51.84 ±1.40

Table (2) shows the mean values of the anthropometric measurements from 10- to 12-year-old boys and girls. The mean age was 10.36 years in boys and 10.33 years in girls. The mean arm span of both boys and girls was smaller than their height. All measurements showed a greater mean in girls than in boys, with the exception of head circumference, head length, and head breadth, which were greater in boys than in girls.

Eleven-year-old boys and girls. The mean age of the boys was 11.33 years, whereas that of the females was 11.39 years. Compared with those of males, girls' arm spans were on average greater than those of boys, and girls' mean values increased in all measurements except arm length and head breadth, which increased in boys.

A total of 12-year-old boys and girls were included. The mean age was 12.38 years in boys and 12.34 years in girls. The mean value of the arm span exceeds the height for both boys and girls. There was a moderately significant difference (P <0.01) in height, which was greater in girls.

Table (2): The comparison of anthropometric measures between 10-12 years' boys and girls.

	10 years (n= 50)		11 years (n= 50)		12 years (n= 50)	
	Boys	Girls	Boys	Girls	Boys	Girls
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
age	10.36±.30	10.33±.23	11.33±.23	11.39±.26	12.38±.29	12.34±.31
height	141.60±5.96	144.72±8.48	148.12±7.92	149.48±5.85	150.04±6.04	155.20±7.01
BMI	17.28±2.61	18.32±2.99	18.79±4.18	20.37±5.76	18.65±3.38	19.89±4.31
arm span	140.96±7.96	144.08±8.45	147.24±8.66	149.84±7.08	150.84±6.91	155.88±8.34
arm length	28.18±1.95	29.72±1.81	30.38±1.89	30.11±1.87	31.13±2.51	32.36±2.68
forearm length	21.42±1.50	22.14±1.63	22.14±1.36	22.90±1.33	23.05±1.38	23.52±1.43
lower limb length	71.20±5.18	74.12±6.20	74.00±4.86	75.76±3.88	76.36±4.94	77.16±3.77
leg length	32.28±2.17	33.80±2.18	34.04±2.79	34.80±1.76	34.40±2.40	35.72±2.25
head length	16.90±.64	16.75±.57	16.80±.66	17.14±.71	16.88±.49	16.89±.64
head breadth	13.07±.54	12.74±.62	13.04±.54	12.72±.63	13.14±.74	13.15±.52
head circumference	52.28±1.37	52.12±1.48	52.44±1.29	53.60±1.63	52.52±1.42	52.72±1.57

Table (3) shows a strong positive correlation between height and most of the other measurements (arm span, arm length, forearm length, lower limb length and leg length) at the ages of 6, 7, 8 and 9 years. Also between height & BMI in 6 year children and between height & head circumference in 7 years children.

Table (3): Correlation between age and height and other parameters at age 6-9 years

		6 years		7 years		8 years		9 years	
		Age	**Height**	**Age**	**Height**	**Age**	**Height**	**Age**	**Height**
BMI	**Pearson Correlation**	.007	.524	-.162-	.254	.081	.461	.097	.325
	P value	.964	< 0.001	.261	.075	.577	.001	.505	.021
arm span	**Pearson Correlation**	.066	.862	.117	.921	.311	.901	.140	.893
	P value	.649	< 0.001	.418	< 0.001	.028	< 0.001	.331	< 0.001
Arm length	**Pearson Correlation**	.009	.711	.030	.662	.254	.722	.130	.688
	P value	.950	< 0.001	.838	< 0.001	.075	< 0.001	.370	< 0.001
Forearm length	**Pearson Correlation**	-.104-	.761	.078	.847	.151	.757	.162	.689
	P value	.474	< 0.001	.592	< 0.001	.295	< 0.001	.261	< 0.001
lower limb length	**Pearson Correlation**	-.072-	.732	.076	.842	.253	.843	.144	.772
	P value	.618	< 0.001	.598	< 0.001	.076	< 0.001	.319	< 0.001
leg length	**Pearson Correlation**	.085	.835	.204	.922	.331	.819	.248	.864
	P value	.556	< 0.001	.156	< 0.001	.019	< 0.001	.082	< 0.001
head length	**Pearson Correlation**	.151	.249	-.088-	.362	.223	.338	.147	.168
	P value	.296	.082	.545	.010	.119	.016	.308	.244
head breadth	**Pearson Correlation**	-.022-	.241	-.066-	.249	.179	.095	.104	.018
	P value	.880	.092	.647	.081	.215	.509	.471	.899
head circumference	**Pearson Correlation**	-.101-	.301	-.081-	.509	.118	.460	.041	.433
	P value	.487	.034	.576	< 0.001	.416	.001	.779	.002

P value <0.05 is significant

Table (4) shows a strong positive correlation between height and arm span, arm length, forearm length, lower limb length and leg length in 10-, 11- and 12-year-old children.
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Additionally, there was a strong positive correlation between age and arm span and forearm length in 12-year-old children

Table (4): Correlation between age and height and other parameters at age 10-12 years.

		10 years		11 years		12 years	
		Age (n= 50)	**Height (n= 50)**	**Age (n= 50)**	**Height (n= 50)**	**Age (n= 50)**	**Height (n= 50)**
BMI	**Pearson Correlation**	-.020-	.306	.075	.264	-.076-	.287
	P value	.893	.031	.604	.064	.599	.043
arm span	**Pearson Correlation**	.367	.847	.106	.938	.464	.964
	P value	.009	< 0.001	.466	< 0.001	.001	< 0.001
Arm length	**Pearson Correlation**	.330	.736	-.012-	.693	.358	.748
	P value	.019	< 0.001	.933	< 0.001	.011	< 0.001
forearm length	**Pearson Correlation**	.359	.812	.150	.865	.534	.829
	P value	.011	< 0.001	.300	< 0.001	< 0.001	< 0.001
lower limb length	**Pearson Correlation**	.230	.904	.128	.832	.252	.798
	P value	.109	< 0.001	.375	< 0.001	.077	< 0.001
leg length	**Pearson Correlation**	.272	.890	.106	.847	.366	.884
	P value	.056	< 0.001	.462	< 0.001	.009	< 0.001
head length	**Pearson Correlation**	.004	.317	-.063-	.262	.006	.355
	P value	.977	.025	.662	.066	.965	.011
head breadth	**Pearson Correlation**	-.010-	-.082-	.082	.073	.312	.285
	P value	.945	.570	.573	.615	.028	.045
head circumference	**Pearson Correlation**	-.154-	.430	.068	.426	-.114-	.317
	P value	.286	.002	.638	.002	.429	.025

P value <0.05 is significant

Table (5) shows a linear regression equation for the prediction of age in 8-, 10-, and 12-year-old children. There was high statistical significance (P <0.001) for leg length in 8-year-old children, for arm length and head circumference in 10-year-old children and for forearm length in 12-year-old children.

Table (5): Linear regression to predict age 8- 10- 12 years

Variables	**Equation**	**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**	**95.0% Confidence Interval for B**	
		B	**Std. Error**	**Beta**			**Lower Bound**	Upper **Bound**
(Constant)	6.766+.058* **leg length**	6.766	.686		9.867	<0.001	5.388	8.145
leg length (8 years)		.058	.024	.331	2.427	.019	.010	.106
(Constant) (10 years)	11.196+.030* **Arm**-.051* **head circumference**	11.196	1.297		8.631	<0.001	8.586	13.805
Arm		.030	.009	.440	3.258	.002	.011	.048
head circumference		-.051-	.025	-.272-	- 2.014-	.050	-.103-	.000
(Constant)	9.723+.113* **forearm**	9.723	.603		16.127	<0.001	8.510	10.935
Forearm (12 years)		.113	.026	.534	4.379	<0.001	.061	.165

P value <0.05 is significant

Table (6) shows a linear regression equation for the determination of sex in 6-year-old children. Head length and head breadth were the variables used to determine sex, with a percentage of correct classification of 72.0%.

In 7-year-old children, head length was the variable used to determine sex, with a percentage of correct classification of 58.0%.

For 9-year-old children, forearm length, lower limb length and leg length were the variables used to determine sex, with a percentage of correct classification of 78.0%.

For 10-year-old children, arm length and head breadth were the variables used to determine sex, with 70.0% correct classification.

In 11-year-old children, head breadth and head circumference were the variables used to determine sex, with a percentage of correct classification of 72.0%. For 11-year-old children, the arm span was the variable used to determine sex, with a percentage of correct classification of 64.0.

Table (6): Linear regression to determine sex , 6-12 years old children

Variables	Equation	Function	Sex	%
	-32.429+.939* **head length**+1.350* **head breadth**	**1**		**72.0%**
head length		.939	**Male =** .638	
head breadth		1.350		
(Constant) 6 years		-32.429-	**Female** = -.638-	
head length	-28.214+1.700* **head length**	**1**	**Male =** .286	58.0%
(Constant) 7 years		1.700		
		-28.214-	**Female = -** .286-	
forearm		**1**		**78.0%**
lower limb	-8.358+.833* **forearm**+.328* **lower limb**-.993* **leg length**	.833	**Male** = .634	
leg length		.328		
		-.993-	**Female** = -.634-	
(Constant) 9 years		-8.358-		
Arm length	1.755+.459* **arm length**-1.165* **head breadth**	**1**	**Male =** -.546-	**70.0%**
head breadth		.459		
(Constant) 10 years		-1.165-	**Female = .**546	
		1.755		
head breadth	-16.802-1.348* **head breadth**+.644* **head circumference**	**1**	**Male = -.587-**	
head circumference		-1.348-	**Female = .587**	**72.0%**
(Constant) 11 years		.644		
		-16.802-		
arm span	-20.022+.131* **arm span**	**1**	**Male = -** .329	**64.0%**
(Constant) 12 years		.131	**Female** = .329	
		-20.022-		

Table (7) shows **a linear regression equation** for the determination of stature in 6–12-year-old children. There were highlysignificant differences in arm span among the 6- and 12-year-old children, arm span and leg length among the 7-year-old children, arm span and lower limb length among the 8- and 10-year-old children, arm span and leg length among the 9-year-old children, and lower limb length among the 11-year-old children.

Table (7): Linear regression to determine stature in, 6-12 years' children**.**

Variables	**Equation**	**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**P value**	**95.0% Confidence Interval for B**	
		B	**Std. Error**	**Beta**			**Lower Bound**	**Upper Bound**
(Constant) (6 years)	19.553+0.446***arm span**+0.333* **lower limb**+.965* **arm**	19.553	7.430		2.632	.012	4.597	34.508
arm span		.446	.095	.508	4.688	< 0.001	.254	.637
lower limb		.443	.134	.287	3.307	.002	.173	.712
arm		.965	.376	.230	2.570	.013	.209	1.721
(Constant) (7 years)	-1.671+1.335***leg length**+.349***arm span**+.588***head circumference**+.305* **lower limb**	-1.671-	8.931		-.187-	.852	-19.658-	16.316
leg length		1.335	.243	.416	5.503	<0.001	.847	1.824
arm span		.349	.076	.372	4.606	<0.001	.197	.502
head circumference		.588	.187	.130	3.145	.003	.211	.965
lower limb		.305	.119	.173	2.559	.014	.065	.544
(Constant) (8 years)	13.566+.474***arm span**+.555***lower limb**+.416***head circumference**	13.566	8.169		1.661	.104	-2.876-	30.009
arm span		.474	.057	.569	8.272	<0.001	.359	.589
lower limb		.555	.094	.394	5.908	<0.001	.366	.744
head circumference		.416	.165	.125	2.517	.015	.083	.748
(Constant) (9 years)	39.481+.441* **arm span**+1.242* **leg length**	39.481	5.447		7.249	<0.001	28.524	50.438
arm span		.441	.063	.561	6.949	<0.001	.314	.569
leg length		1.242	.231	.433	5.369	<0.001	.776	1.707
(Constant) (10 years)	10.600+.477* **arm span**+.529* **lower limb**+1.549* **head length**	10.600	9.819		1.080	.286	-9.164-	30.363
arm span		.477	.085	.532	5.594	<0.001	.306	.649
lower limb		.529	.119	.417	4.457	<0.001	.290	.768
head length		1.549	.563	.126	2.752	.008	.416	2.681
(Constant) (11 years)	20.653+.446***arm span**+.357* **lower limb**+.486***arm**+.909 ***forearm**	20.653	5.846		3.533	.001	8.878	32.428
arm span		.446	.090	.511	4.945	<0.001	.265	.628
lower limb		.357	.116	.229	3.068	.004	.122	.591
Arm length		.486	.221	.131	2.194	.033	.040	.932
Forearm length		.909	.415	.182	2.189	.034	.073	1.745
(Constant) (12 years)	23.568+ .841* **arm span**	23.568	5.176		4.553	<0.001	13.161	33.976
arm span		.841	.034	.964	24.965	<0.001	.774	.909

DISCUSSION

The objective of this research was to determine the statistical relationships among stature; age; sex; anthropometric measures of the head, upper and lower extremities; and body mass index (BMI) in a sample of Egyptian school-aged children (6–13 years old).

In the present study, Behera (rural) boys were taller than girls were at ages 6, 7 and 9, whereas girls were taller at ages 8, 10, 11 and 12. Girls were heavier than boys at all ages above 8 years, whereas boys were heavier than girls at ages 6 and 7. These results align with those of **Reyes et al. (2003),** who reported that, among rural children, at all ages, boys were taller than girls. and heavier than girls between the ages of 6 and 9; girls were heavier between the ages of 10 and <13. These findings also support the findings of **Dana et al. (2011),** who discovered that boys were heavier and taller than girls in their investigation. Additionally, this finding is consistent with that of **Tee et al. (2002),** who reported that boys seemed to be taller than girls in the 7- and 8-year-old groups. In contrast, the girls' mean height was significantly greater than the boys' mean height in the 9- and 10-year-old groups.

These findings are consistent with research conducted in 2007 by **Semproli and Gualdi-Russo** on rural children, which reported that girls were taller at ages 11 and 12, whereas boys were taller at ages 7 and 9. It was also discovered that, at ages 8 to 12, girls were heavier than boys.

The mean BMI for boys in this study was greater at ages 9 and 10 years, and it was greater at ages 7 and 8 years for girls. These results contradict those of **Tee et al. (2002)**, who reported that, compared with girls, boys had a higher mean BMI in all age groups. Furthermore, these findings contradict the findings of **Semproli and Gualdi-Russo (2007)**, who reported that girls were taller at age 6 and that boys were taller than girls in rural areas at ages 8 and 10. Moreover, at ages 6 and 7, girls were heavier than boys were, and at age 12, boys were heavier than girls were.

The findings of the present study can be explained by the fact that females reach puberty at a younger age (10–13 years) than boys do and that their growth happens before boys' puberty.

The current study revealed that children from Behera had mean arm span values that were lower than their heights at the ages of 6–11 years in boys and girls but exceeded their height at the ages of 11–13 years in both sexes. The mean arm span was longer in girls than in boys at the ages of 8, 10, 11 and 12 years but was longer in boys at the ages of 6, 7 and 9 years. These findings concur with those of **Dorjee and Sen (2016),** who reported a substantial link between height and arm span in their study of rural children.
These findings are at odds with those of **Zverev and Chisi (2005),** who reported that in older girls and boys of all ages, the average arm span values were greater than the height.

The present study revealed that at the ages of 6, 8, 10, and 12 years, girls had longer **mean arm lengths** than boys did, but at the ages of 7, 9, and 11 years, boys had longer mean arm lengths. These results are in agreement with those of **Zhu et al. (2015),** who reported that there was a positive relationship between height and arm length. At ages 6–> 12 and 13–17, the mean arm length was greater in males than in girls but longer in girls at age 12.

In Behera children, the **lower limb length** was longer in boys than in girls aged 6–<10 years, whereas it was longer in girls aged 10–<13 years, and it was greater in girls than in boys, which is the age of pubertal growth for girls.

These findings are consistent with those of **Pal and Bose (2017),** who reported that Indian rural boys between the ages of 6 and 7 had larger lower limbs. The boys' lower limb length ranged from 53.0 to 61.5 cm, whereas the girls' lower limb length ranged from 52.8 to 58.8 cm. This is less than the study's lower limb lengths, which are 58.52–74.12 for girls and 59.72–71.20 for boys.

These findings conflict with those of **Pal and Bose (2017),** who reported that lower limb length was greater in boys and girls at age 10 and in rural girls and boys at age 8. Additionally, **Rao et al. (2000)** reported that 9-year-old girls had longer lower limbs. This may be connected to girls' earlier onset of puberty.

In the present study, the mean head length was greater in boys at all ages except ages 11 and 12. This aligns with the findings of **Vinitha et al. (2015)**, who reported that boys had longer average heads than girls did. There was also a positive correlation between head length and height.

However, these findings contradict those of **Hansi and Ashish (2013),** who demonstrated that the mean head length was 16.76–16.65 cm in boys and 16.26–16–73 cm in girls aged 6–10 years. Genetic and environmental factors, such as food practices, vitamin deficits, and ethnic heterogeneity, may be connected to this. Nevertheless, they concur that there was a strong positive association between head length and height.

In our study, boys had a greater mean head circumference at every age except for twelve, where it was greater in girls. In their study of rural children, **Little et al. (2006)** reported that boys had a greater mean head circumference than girls did in all age groups, ranging from 14.4–14.6 cm in boys and 13.9–14.5 cm in girls at ages 6–<13 years **(**which is slightly greater than the mean values reported in the present study (12.98–13. 14 cm in boys and 12.30–13.15 cm in girls), which may be related to ethnic differences.

In our study, head circumference was greater in boys at ages 6, <8, 9, and <11 years, whereas at ages 8, 11, and 12 years, the mean head circumference was greater for girls. This is consistent with **Pal and Bose's (2017)** findings from their study on rural children, which showed that boys had greater head circumference measurements at the ages of 6, 7, 9, and 10 years, with a range of 49.0--49.0 cm for boys and 47.3--48.5 cm for girls. This finding is comparable to the findings of the present study (50.92–52.28 cm for boys and 49.84–52.12 cm for girls). Despite this, boys had greater mean head circumference measurements at 8 years of age.

In the present study, among various anthropometric parameters, arm span and lower limb length were shown to have the strongest correlation with stature, but leg length was highly significantly correlated with age (9 years), arm length (6 & 11 years), head circumference (7 & 8 years), and head length (10 years).

Zverev and Chisi (2005) reported that while the height-to-arm span ratio decreased, the differences in children's stature, arm span, and stature–arm span increased with age. Multiple linear regression analysis produced the following equation: height = 15.756 + (0.168 × age) + (0.839 × arm span).

In their study of rural children, **Dorjee and Sen (2016)** reported the following equation for predicting height via arm span, leg length, and arm length: Height is equal to “11.600 + arm span” (0.719) + leg length (0.498) + arm length (0.180).

Chowdavarapu et al. (2015) developed a predictive model to estimate the height of 318 students between the ages of 8 and 11 years, based on head length: Height = 11.602 × (Head Length) **-** 66.309.

CONCLUSIONS

The means of most anthropometric measurements were **greater in girls**. There was a **significant positive association** between height and BMI, arm length, arm span and forearm length, head circumference across all age groups, and lower limb and leg lengths. Several regression equations were used to estimate the age, sex and stature of the children.

Recommendations: Similar research processes are needed on other governorates and a larger number of children are needed to compare the development and growth characteristics under different environmental conditions. A vision of nutritional needs and health services in different communities is provided.

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List of abbreviations:

BMI: body mass index

UAL: upper arm length

MHL: Maximum Head (antro-posterior) Length

MHB: The maximum head breadth

HC: Head Circumference

AS: Arm Span

UAL: upper arm length

FAL: forearm length

LLL: Lower Limb Length

LL: Leg Length

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الملخص العربي

تقييم العمر والجنس والقامة ببعض القياسات الأنثروبومترية في عينة من أطفال الريف المصري

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ان طول القامة هو سمة متأصلة في الفرد، ويعتبر تقييمًا مهمًا في التعرف على بقايا بشرية غير معروفة. كان الغرض من الدراسة الحالية معرفة الارتباط الإحصائي بين العمر والجنس والقامة والقياسات الأنثروبومترية للرأس والأطراف العلوية والسفلية ومؤشر كتلة الجسم في عينة من أطفال الريف المصري في سن المدرسة (٦->١٣ عامًا). اجريت الدراسة الحالية على ٣٥٠ طفلًا سليمًا تتراوح أعمارهم بين ٦ و> ١٣ عامًا تم اختيارهم عشوائيًا من المدارس الابتدائية بمحافظة البحيرة. ثم تم إجراء تقييم العمر والجنس والقامة من خلال البيانات الاجتماعية والديموغرافية والقياسات الأنثروبومترية. النتائج: في هذه الدراسة، أظهرت معايير قياس الجسم المختلفة أن طول الذراع وطول الطرف السفلي لهما أقوى ارتباط بالقامة، ولكن طول الساق كان مهمًا للغاية في سن ٩ سنوات، وطول الذراع في سن ٦ و١١ عامًا، ومحيط الرأس في سن ٧ و٨ سنوات، وطول الرأس في سن ١٠ سنوات. استنتاجا من الدراسة كانت متوسطات معظم القياسات الأنثروبومترية أعلى لدى الفتيات، وتم إجراء العديد من معادلات الانحدار لتقدير العمر والجنس وقامة الأطفال