RESEARCH ARTICLE

BODY HEIGHT AND ITS ESTIMATION UTILIZING ARM SPAN MEASUREMENTS AMONG MEDICAL STUDENTS IN UNIVERSITY OF SANA'AAND UNIVERSITY OF SCIENCE AND TECHNOLOGY IN SANA'A CITY,YEMEN: AN ANTHROPOMETRIC STUDY

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Manuscript Info

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Abstract

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Background: Arm span is the most reliable anthropometric measurement to estimate the height of an individual. Objective the present study was under taken to measure the height as well as arm span and to determine whether there is any correlation between the height and the arm spanamong medical students in university of Sana'a as the government university and university of science and technology(UST) as the private university in Sana'a city, Yemen. Cross sectional study was carried out with a total number of 396, with equal size of gender, aged between 17 to 27 years. Height and arm span were measured by using anthropometric techniqueconducted from October to December 2020. The data statistically analyzed by computation to find out its normative value. The relationship between body height and arm span were determined using simple correlation coefficients. Result: males had higher means in height and arm span, the differences weresignificant.All parameters were higher for students of UST, differences arm span were significant (p values < 0.05), no significant differences were found according to their study level, the difference in height and arm span between males and females weresignificant, there were a strong positive correlation between arm span and height. The correlation coefficient for males was 0.555, for females was 0.602, and overall correlation for total sample was 0.762. In conclusion these correlations were statistically significant.Therefore, the arm span measure seems to be a reliable indirect anthropometric measurement for estimating body height in adults.

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Introduction:-

It is well known in scientific literature that the measurement of body height is important in many settings: it is an important measure of body size and gives an assessment of nutritional status[1].

Arm span as the anthropometric indicator used as an alternative to estimate body height. It is very important in identifying individuals with disproportionate growth abnormalities and skeletal dysplasia or body height loss during surgical procedures on the spine[2].

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The exact body height cannot always be determined the usual way because of various deformities of the extremities or in patients who have undergone amputations or similar injuries. In such circumstances, an estimate of body height has to be derived from other reliable anthropometric indicators, such asarm span[3,4]. Several studies have reported the effectiveness and reliability of using various body parameters in predicting body height and arm span[4,5].

Even though several studies of this nature are available on western and Indian population but not available data on Yemeni population. So, the purpose of this study was to examine the body height in both sexes among medical students of university of Sana'a and university of science and technology in Sana'a city, Yemen. To get the relationship between arm span and body height.

Methods:-
Subjects A convenience sample (n = 396) of equal numbers of consenting adult male and female, aged 17 to 27 years were recruited to participate in this study. The study sample had to be free from any skeletal abnormalities, able to stand erect unaided and have no amputations that could influence the accurate measurement of stretch stature or arm span. The study setting was the University of Sana'a and University of Science and Technology in Sana'a city, Yemen. A cross-sectional study design was employed. All anthropometric measurements, including height, arm span, were measured by nutritionist using the International Standards for Anthropometric Kinanthropometry (ISAK). Each measurement method was conducted by the same fieldworker. All measurements were performed in triplicate and recorded to the nearest 0.1 cm. The mean of the two closest values was captured. A pilot study was conducted on a convenience sample (n = 10) of young adult of both genders with inclusion and exclusion criteria. The pilot study was used to test the plausibility of the research question and also for standardization of anthropometric measurement techniques between fieldworkers. Ethics approval was granted by the University of Science and Technology-Medical and Health Science-Clinical Nutrition and Dietetics Department.Prior to data collection, the purpose of the study was explained to each participant and all were required to sign an informed consent form. The Statistical Package for Social Sciences SPSS version 21) was used to perform the statistical analysis. Chi square test will have used to test variable differences. Test considered to be significant if (p value) < 0.05. The Height and arm span measurements were used in calculations: (i) half-arm span multiplied by two; and (ii) the WHO equation[6,7]. Summary of measurement methodology: Estimate Method Ref. Stretch stature: Subject stood without shoes, with heels, buttocks and upper back touching the stadiometer. The head was placed in a Frankfort plane. One recorder placed one hand on either side of the subject's jawline to position the head and apply 'upward pressure' into the mastoid processes. The other recorder asked the subject to take a deep breath and hold it, while the head board was placed onto the vertex (top of the head)[8].

Arm span:
Subject stood without shoes, with heels, buttocks and upper back touching a wall with an even surface. Both arms were simultaneously placed in a horizontal plane in line with shoulders with arms at a 90° angle in relation to the body. Arms were outstretched laterally, with palms facing outwards. Two fieldworkers stood on either side of the subject, holding a non-elastic measuring tape flat against the wall. Fieldworkers subsequently measured arm span by measuring the distance from the dactylion (tip of middle finger) on the left hand to the dactylion of the right hand[9].Half-arm span x 2: A similar body position to that reported for arm span was used for measuring half-armspan. The difference in measurement taken was that the distance spanned from the dactylion of the right hand to the suprasternal notch (on the mid-sternal line) using non-elastic tape. The mean value obtained was multiplied by two to provide an estimate of height, based on arm span[10,11].

Results:-
A summary of the anthropometric measurements in both sexes is shown in Table below: The Distribution of the sample according to age

This study has included 396 medical students. Their ages ranged between 17 years and 27 years, with mean and SD 21.6 ± 1.4 years. The majority of students (66.2%) were in the age of 20 to 22 years, and minority of them (5.8%) were less than 20 years.

Table 1:- Distribution of the sample according to age.

Age categories	Count	Percent
From 17 to 19 years	23	5.8%
From 20 to 22 years	262	66.2%

More than 22 years	111	28%
Total	396	100%

Minimum = 17 years, Maximum = 27 years, Mean ± SD = 21.6 ± 1.4 years.

Distribution of the sample according to gender

The study has included equal numbers of both gender (198 males, and 198 females).

Table2:- Distribution of the sample according to gender.

Gender	Count	Percent
Males	198	50%
Females	198	50%
Total	396	100%

Distribution of the sample according to the university type

The study has conducted on equal numbers in both medical colleges (198 students in UST, and 198 students in Sana'a University).

Table3:- Distribution of the sample according to the university type.

University	Count	Percent
UST	198	50%
Sana'a University	198	50%
Total	396	100%

Distribution of the sample according to the level

Sample was taken from 2nd, 3rd, and 4th levels. Each level represented one third of the sample. That was 132 (33.3%) in each level.

Table4:- Distribution of the sample according to the level.

Level of students	Count	Percent
Level 2	132	33.3%
Level 3	132	33.3%
Level 4	132	33.3%
Total	396	100%

Comparing anthropometric parameters according to gender

Table below depicts differences in anthropometric measurements between males and females. Males have higher means inheight,weight,arm span, waist circumference, wrist circumference, and mid upper arm circumference (MUAC). The differences are significant. However, there is no significant difference in hip circumference.

Table5:- Comparing anthropometric parameters according to gender.

Anthropometric measure	Gender	Count	Mean	Minimum	Maximum	Standard Deviation	P value
Height (cm)	Males	198	168.05	135.00	183.20	6.94	0.000*
	Females	198	156.00	142.00	175.40	5.74	
Arm span (cm)	Males	198	175.41	156.00	197.00	8.37	0.000*
	Females	198	161.15	142.00	199.00	8.59	

*Significant difference in means between males and females.

Comparing anthropometric parameters according to university

Table below compares means of anthropometric measures for UST students Sana'a University students. All parameters are higher for UST students. Differences in weight, arm span, hip circumference, and mid upper arm circumference are statistically significant (p values < 0.05).

Table6:- Comparing anthropometric parameters according to university.

Anthropometric measure	University	Count	Mean	Minimum	Maximum	Standard Deviation	P value
Height (cm)	UST	198	162.80	139.30	183.20	9.30	0.079
	Sana'a	198	161.25	135.00	182.50	8.15	

	University						
Arm span (cm)	UST	198	169.68	144.00	199.00	10.87	0.011*
	Sana'a University	198	166.87	142.00	196.00	11.14	

*Significant difference in means between UST students and Sana'a University students.

Comparing anthropometric parameters according to level
Table below illustrates means of anthropometric measures for students according to their study level. No significant differences were found.

Table7:- Comparing anthropometric parameters according to level.

Anthropometric measure	Level	Count	Mean	Minimum	Maximum	Standard Deviation	P value
Height (cm)	Level 2	132	162.44	139.30	183.20	8.52	.396
	Level 3	132	161.18	142.00	181.00	8.27	
	Level 4	132	162.45	135.00	182.50	9.47	
Arm span (cm)	Level 2	132	168.00	142.00	192.00	9.87	.937
	Level 3	132	168.35	144.00	197.00	11.51	
	Level 4	132	168.48	142.00	199.00	11.83	

Height and arm span according to gender
Table below shows that the height of males ranges from 135 to 183 cm with a mean of 168.04 ± 6.9 cm, while height of females ranges from 142 to 175.4 cm with a mean of 155.99 ± 5.7 cm. The difference in height between males and females is statistically significant.The arm span of males ranges from 156 to 197 cm with a mean of 175.4 ± 8.3 cm, while arm span of females ranges from 142 to 199 cm with a mean of 161.14 ± 8.5 cm. The difference in arm span between males and females is statistically significant.

Table 8:- Height and arm span according to gender.

Parameter	Gender	Count	Mean ± SD	Minimum	Maximum	P value
Height (cm)	Males	198	168.04±6.9	135	183	0.000
	Females	198	155.99±5.7	142	175.4	
Arm span (cm)	Males	198	175.4±8.3	156	197	0.000
	Females	198	161.14±8.5	142	199	

Correlation between arm span and height
Table below shows that there is a strong positive correlation between arm span and height. The Correlation Coefficient for males is 0.555, for females is 0.602, and overall correlation for total sample is 0.762. These correlations are statistically significant.

Table 9:- Correlation between arm span and height.

Gender	Count	Correlation Coefficient	P value
Males	198	0.555	0.000
Females	198	0.602	0.000
Overall	396	0.762	0.000

Discussion:-
In our studybody height and its estimation utilizing arm span measurements among medical students of university of Sana'a and university of science and technology in Sana'a city, Yemen: As an Anthropometric study had included 396 of medical students from 2nd, 3rd, and 4th levels. Each level represented one third of the sample. That was 132 (33.3%) in each level.Equal numbers of both gender (198 males, and 198 females) and equal numbers in both medical colleges (198 students in UST, and 198 students in Sana'a University).Their ages ranged between 17 years and 27 years, with mean and SD 21.6 ± 1.4 years. The majority of students (66.2%) were in the age of 20 to 22 years, and minority of them (5.8%) were less than 20 years. Males had higher means inheight and arm span. The

differences were significant. Compares means of anthropometric measures for UST students and Sana'a University students, arm span was higher for UST students than Sana'a University students, differences in arm span, was statistically significant (p values < 0.05). Means of anthropometric measures for students according to their study level, no significant differences were found.

The estimation of body height using various anthropometric measurements has attempted bymany authors in many studies over the centuries by (Mohanty S.P., et al.2001and RaoJ, et al.2009).As already mentioned, all of them estimated body, height from various anthropometric measurementsbut it is important to emphasize that the arm spanhas been derived the most reliable body indicatorfor predicting the body height of an individual[2,4].Rolfe D.L, et al.2002 and Marilyn S & Chenier T. 1990) hadreported, individual and ethnic variations inrespect of body height and its relation with armspan were already observed in European[12,13].

Mohanty S.P.et al.2001) reported the arm span was nearly 8.3centimeters more than the body height for the blackpopulation (105.36% body height), whereas for thewhite population this difference was only 3.3centimeters (102.04% body height). The arm spanwas nearly 2.5 centimeters more than the bodyheight in South Indian females (101.4% bodyheight), which is similar to that noted in the whitepopulation[2].And(Rao J ,et al.2009) reported the arm span was 5.8 centimeters more than body height for Nigerian males (103.3% body height), whereas for Nigerian females this difference was only 4 centimeters (102.5% body height) which is similar to that noted in the white population[4].In our study,the height of males ranges from 135 to 183 cm with a mean of 168.04±6.9 cm, while height of females ranges from 142 to 175.4 cm with a mean of 155.99±5.7 cm. The arm span of males ranges from 156 to 197 cm with a mean of 175.4±8.3 cm, while arm span of females ranges from 142 to 199 cm with a mean of 161.14±8.5 cm, means that the differences of mean of height and arm span between males was 7.36 cm higher in arm span than height , while the differences of mean of height and arm span between females was5.15cm higher in arm span than height, which is nearly to that noted by (Rao J ,et al.2009)in Nigerian males and females with take in consideration the different situation between two studies.

Hence, in the present study it was observed that,the difference in height between males and females is statistically significant. The difference in arm span between males and females is statistically significant. In conclusions there is a strong positive correlation between arm span and height.

Therefore, the arm span measure seems to be a reliableindirect anthropometric measurement for estimating body height in adults. The result of ourstudy is similar to that of study carried out byprevious researchers. The Correlation Coefficient for males is 0.555, for females is 0.602, and overall correlation for total sample is 0.762. These correlations are statistically significant.

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