

Comparative Analysis of the Anthropometric Parameters Among the Ethnic Groups of Karachi

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Abstract

Objective: Objectives of this study were to determine the average height, weight, BMI, BSA and LBM among the different ethnic groups that exist in population of Karachi and to determine whether these anthropometric parameters vary significantly among the ethnic groups.

Methods: It was a prospective cross-sectional study that was carried out at Ziauddin University and Hospital from March 2012 to May 2014. In this study healthy volunteers aged 21 years and above were recruited. Height, weight, body mass index (BMI), body surface area (BSA) and lean body mass (LBM) of healthy volunteers were taken into account through the standard protocol after following inclusion and exclusion criteria. The study was approved by the ethical review committee IRB and BASR committee of Ziauddin University Clifton Karachi.

Results: Greatest height 169.5 ± 9.1 cm and weight 73.4 ± 15.4 kg was found in Pathans. Highest body mass index (BMI) 27.1 ± 4.3 kg/m², body surface area (BSA) 1.8 ± 0.2 m² and lean body mass (LBM) 52.6 ± 9.6 kg was found in Hazarah group. Weight, BMI and BSA was found to vary significantly among the ethnic groups ($p < 0.05$) while height and LBM was found to vary insignificantly among the ethnic groups. Anthropometric parameters vary significantly between the genders among all the ethnic groups. Beside BMI all the anthropometric parameters were significantly greater in males.

Conclusion: Anthropometric parameters noted among the ethnic groups in Karachi were very close to the studies done in the different provinces of Pakistan. In almost all the ethnic groups, BMI males were found to have significantly greater anthropometric parameters as compare to the females.

Keywords: Ethnic groups, urban population, gender identity, body height, body weight, body mass index, body surface area

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Introduction

Nutritional screening programs play an important role in estimating the nutritional status of a population accurately and in identification and prevention of malnutrition of a population. Anthropom-

etry is defined as an evaluation of body dimensions. It is a simple and reliable method for calculating body size and proportions. It is one of the most reliable screening tools for nutritional screening as it gives approximate measures of body stores. Anthropometric parameter such as height, weight, waste-hip ratio, head circumference, skin fold thickness, body mass index (BMI), body surface area (BSA) and lean body mass (LBM) of healthy individual varies all over the world. Genetics, environmental and physiological factors that are known to influence anthropometric parameters includes ethnicity, family traditions and cultural background^{1,2,3}. Globalization and increasing urbanization, changes in lifestyle and mechanized workplaces has affected dietary

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habits and physical activity. All this either directly or indirectly affect the anthropometric parameters⁴.

Human height is a complex and most easily measurable anthropometric parameter. Adult height is determined by genetic potential and by net nutrition status especially during childhood. Many genetic and epigenetic factors are known to influence the height. Race specific variants are now also known to influence height^{5,6}. Adult height is determined by genetic potential and by net nutrition status especially during childhood because it remains stable in adulthood, it has been targeted for extensive research across numerous fields of science¹.

Weight is another easily measurable anthropometric trait. Socioeconomic status contributes enormously in ethnic differences in diet and exercises. It also represents the current nutritional status of population^{7,8}. Obesity, which is majorly caused by excessive intake of food and less physical exercise, is also greatly influence by genetic traits. Various twins and adoption studies reported strong genetic link with obesity^{4,9}. Studies also proved that numerous chronic diseases such as hypertension¹⁰, hyperlipidemia¹¹, diabetes mellitus¹² and several types of cancers¹³ are greatly associated with obesity.

Weight status is commonly defined in terms of body mass index (BMI). BMI is recommended by the World Health Organization (WHO) to determine obesity. It has been classified as underweight (BMI<18.5kg/m²), normal (BMI=18.5-24.9kg/m²), overweight (BMI=25-29.9kg/m²) and obese (BMI>30kg/m²)¹⁴. BMI is considered as gold standard for identifying patients at risk of adverse health outcomes. Direct association between BMI and the risk of morbidity and mortality has been demonstrated multiple times in numerous studies previously¹⁵. Previous studies also suggested that appropriate awareness regarding weight is strongly recommended for weight loss effort as well as for BMI classification¹⁶.

Body Surface area (BSA) is a parameter that measures the total area of the outer layer of body.

It is used in the calculation of drug dosages in individual of different body sizes and also for normalizing physiological parameters (cardiac output and renal clearance). It vary greatly in normal weight, obese and overweight persons^{17,18}. BSA is commonly measured by Dubois formula¹⁹.

Total body weight is a summation of fat mass and fat free mass. Fat free mass (FFM) includes mass of bones, muscles, vital organs and extracellular fluid. Lean body mass (LBM) is slightly different from FFM as lipids in cell membranes are also included in LBM. However, this difference between the LBM and FFM accounts for only a small portion of total body weight (up to 3% in men and 5% in women). LBM is calculated by subtracting the weight of body fat from total body weight (TBW) and it declines with increase in age. Genetic variations in LBM and body fat mass may predispose people of different ethnic identities to a different muscularity and adipose deposition. Previous studies have also suggested that LBM predicts drug dosage better than other parameters^{20,21}.

Karachi is the city of multiple language, culture and ethnicity. It is the largest cosmopolitan city of Pakistan in terms of population, business and geographical location. People from different region of Pakistan reside here for better job opportunities, business growths, lifestyle modification, medical facilities, educational reforms and many more. As a consequence multiple ethnic groups exist in Karachi that includes Urdu speaking, Sindhi, Pathan, Punjabi, Baloch, Hazarah, Saryaki, Kashmiri and so on^{22, 23}. The knowledge of anthropometric measure of a city or country is vital to be updated. These measures are significantly affected by environment, nutrition and life style. Genetics and epigenetics seem to play an important role too. Objectives of this study were to determine the average height, weight, BMI, BSA and LBM among the different ethnic groups that exist in Karachi population and to determine whether these anthropometric parameters vary significantly among the ethnic groups.

Subjects and Methods

It was a prospective cross-sectional study that was carried out in Karachi. In this study apparently healthy population aged 21 years and above was included. Participants were gathered through convenient sampling from March 2012 to May 2014. Both verbal and written consents were taken from all the selected participants. They were then asked to fill proforma that included the information regarding their age, gender, ethnicity, socioeconomic status, medical history and drug history. Female participants were also asked about their menstrual history and pregnancy. Volunteers with physical disabilities and known hormonal disease were not included in the study. Females with pregnancy were also excluded from the study. Inclusion criteria of the study were the ability to speak and to stand for weight and height measurements.

Anthropometric measurements were taken carefully by using normal standard anthropometric techniques. Following anthropometric parameters were noted:

Height was measured in centimeter (cm) by asking the volunteers to stand straight in anatomical position without shoes.

Weight was measured in kilogram (kg) by asking the volunteers to stand straight in anatomical position without shoes and all pockets emptied.

BMI was calculated by WHO recommended formulas: $\text{weight}/\text{height}^2$ and was measured in (kg/m^2).

BSA was calculated by Dubois formula = $0.20247 \times \text{height (m)} \times 0.725 \times \text{weight (kg)}$ 0.42519.

LBM was calculated by James formula: LBM (Males = $(1.10 \times \text{weight (kg)}) - 128 \times (\text{weight}^2 / (100 \times \text{Height (m)})^2)$). LBM (Females = $(1.07 \times \text{weight (kg)}) - 148 \times (\text{weight}^2 / (100 \times \text{Height (m)})^2)$).

The study was approved by the ethical review committee IRB and BASR committee of Ziauddin University Clifton Karachi.

All data was entered on Microsoft excel and was analyzed on SPSS version 21. Descriptive statistics was used to analyse the means and standard deviations of anthropometric parameters among the ethnic groups of the study. Kolmogorov-Smirnov test was applied to check the normality. As the data follow the normality assumption, ANOVA test was used to determine the level of significance among the ethnic groups of study. Student T-test was applied to determine the significance between the genders in all the ethnic groups of study.

Results

Mean age of 416 apparently healthy volunteers participated in the study was 42.1 ± 15.2 years. Total 220 males and 196 females participated in this study. Mean age of males and females participated in the study was 43.2 ± 16 and 41 ± 14.4 years respectively. The difference in the mean age of volunteers between the two genders was insignificant ($P=0.127$).

Mean and standard deviations of anthropometric parameters of 416 healthy volunteers participated in this study was noted as height 165 ± 9.5 cm, weight 69.5 ± 14.9 Kg, BMI 25.5 ± 5.3 Kg/m^2 , BSA 1.78 ± 0.2 m^2 and LBM 50.2 ± 8.8 Kg.

Table 1 represents the mean and standard deviations of anthropometric parameters noted among the ethnic groups in Karachi. Weight, BMI and BSA was found to vary significantly among the ethnic groups ($P<0.05$). Height and LBM was found to vary insignificantly among the ethnic groups ($P>0.05$). Pathan were tallest 169.5 ± 9.1 cm, Hazarah group were heaviest 73.6 ± 13.6 kg, BMI 27.1 ± 4.3 kg/m^2 , BSA 1.8 ± 0.2 m^2 and LBM 52.6 ± 9.6 kg was also greatest in Hazarah group.

Table 2 represents the mean height, weight, BMI, BSA, and LBM between the genders in the ethnic groups of Karachi population. Among all the ethnic groups male were found to have greater anthropometric parameters when compare to females beside BMI.

Table 1. Mean with standard deviation of anthropometric parameters among the different ethnic groups

Ethnicity	Height cm	Weight kg	BMI ψ kg/m ²	BSA ψ m ²	LBM ψ Kg
Urdu speaking n=120	164.4 ±9.6	67.2 ±15.2	24.8 ±5.1	1.7 ±0.2	49.3 ±9.5
Sindhi n=45	165.6 ±10.22	67 ±12.6	24.5 ±4.4	1.7 ±0.2	49.6 ±8.1
Pathan n=149	169.5 ±9.1	73.4 ±15.4	26.7 ±5.8	1.8 ±0.19	51.7 ±8.6
Punjabi n=80	164 ±9.9	67.2 ±13.4	25.1 ±5.2	1.73 ±0.17	48.9 ±8.2
Hazarah n=17	164.7 ±10.5	73.6 ±13.6	27.1 ±4.3	1.8 ±0.2	52.6 ±9.6
Baloch n=5	166.4 ±2.1	63.8 ±0.8	23.1 ±0.3	1.7 ±0.02	48.5 ±3.4

P-Value 0.784 0.001* 0.005* 0.005* 0.073
 *Correlation is significant at the P-Value \leq 0.05 level (ANOVA).
 ψ Body mass index, body surface area and lean body mass

Discussion

Anthropometric parameters are characteristic to every population. Genetic makeup and environmental factors affect the anthropometric parameters of a population. Ethnic difference in body fat distribution, muscularity, bone mass and bone length is also very well documented^{1,46}. Previously, studies determined anthropometric parameters in different provinces of Pakistan separately^{5,18}. To the best of our knowledge so far, no study determined the means of anthropometric parameters among the ethnic groups that exist in Karachi population. Objectives of this study were to determine means, height, and weight, BMI, BSA and LBM among the ethnic groups in Karachi population and also to determine whether these changes are significantly different among the ethnic groups.

Table 2. Anthropometric parameters between the genders among the ethnic groups

Ethnic Groups	Urdu speaking		Sindhi		Pathan		Punjabi		Hazarah		Baloch	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
n=	59	61	24	21	83	66	42	38	10	7	2	3
Mean	169.8	159.2	172.9	157.3	171.3	159.3	170	157.4	170.5	156.4	168.5	165
Height (cm)	±1.12	±1.0	±1.09	±1.7	±0.72	±0.9	±1.24	±1.15	±2.77	±2.4	±0.5	±0.6
P-Value	0.001*		0.0001*		0.0001*		0.0001*		0.003*		0.025*	
Mean	73.9	60.6	69.3	64.4	74.5	71.9	68.4	65.8	79.6	65	64.5	63.3
Weight (kg)	±1.9	±1.7	±2.1	±3.2	±1.4	±2.3	±2.3	±1.9	±4.2	±3.5	±0.5	±0.33
P-Value	0.0001*		0.192		0.316		0.388		0.024*		0.133	
Mean	25.7	23.8	23.3	25.9	25.3	28.5	23.7	26.7	27.4	26.7	22.7	23.3
BMI ψ (kg/m ²)	±0.7	±0.5	±0.8	±1	±0.4	±0.9	±0.7	±0.9	±1.3	±1.8	±0.04	±0.1
P-Value	0.041*		0.048*		0.001*		0.009*		0.776		0.017*	
Mean	1.8	1.62	1.8	1.64	1.9	1.73	1.9	1.66	1.8	1.65	1.9	1.7
BSA ψ (m ²)	±0.02	±0.02	±0.02	±0.04	±0.02	±0.03	±0.02	±0.02	±0.03	±0.03	±0.05	±0.08
P-Value	0.0001*		0.001*		0.0001*		0.002*		0.003*		0.049*	
Mean	56.1	42.8	55.1	43.4	57.3	44.7	53.8	43.6	59.1	43.3	52.2	45.9
LBM ψ (kg)	±0.9	±0.8	±1.1	±1.2	±0.77	±0.5	±1.2	±0.7	±2.1	±1.3	±0.37	±0.27
P-value	0.0001*		0.0001*		0.0001*		0.0001*		0.0001*		0.001*	

*Correlation is significant at the P-Value \leq 0.05 level (T-test)
 ψ Body mass index, body surface area and lean body mass

Ethnic variations in anthropometric parameters are very well known. Height is complex yet an important anthropometric trait that is regulated by the genetic and environmental factors both. Among the ethnic groups of Karachi that were included in this study, Pathans were found to be tallest 169.5 ± 9.1 cm and Urdu speaking folks were shortest 164.4 ± 9.6 cm. However, the difference of height among the ethnic groups was insignificant ($P= 0.784$). Khan et al in 2008 reported average height of 162 ± 11 cm from three provinces of Pakistan. Average male height 168 ± 8 cm was found to be significantly greater when compare to the females 152 ± 7 cm in females ($P= 0.0001$)²⁴. In this study height was significantly greater in the males of all the ethnic groups.

Weight is another important anthropometric parameter used in the study and is greatly related to the socioeconomic status and genetic factors. In this study mean weight was found to be highest in Pathan 73.4 ± 15.4 kg and lowest among Baloch 63.8 ± 0.8 kg and was found to differ significantly among all the groups ($P= 0.001$). Khan et al reported average weight of 62 ± 12 kg in Pakistani population and it was significantly greater in males 66 ± 12 kg when compare to the females 56 ± 12 kg ($P<0.05$)²⁴. In this study weight was found to be significantly greater only in the males of Urdu speaking and Hazarah.

Obesity is a now an epidemic health problem worldwide and being overweight is a risk factor for numerous chronic diseases including hypertension, diabetes, hyperlipidemia, coronary heart diseases, asthma and many more. Weight status of an individual is measured in terms of BMI (kg/m^2). National institute of Health and WHO has classified BMI into underweight, normal, overweight and obese. BMI has become gold standard for identifying individuals at increased risk of obesity related adverse health outcome. In this study, BMI was also found to differ significantly among the ethnic groups ($P= 0.005$). It was found to be highest in Hazarah 27.1 ± 4.3 kg/m^2 and lowest in Baloch 23.1 ± 0.3 kg/m^2 . Khan et al reported average BMI

of 24 ± 5 kg/m^2 in Pakistani population and it was significantly greater in females 24 ± 5 kg/m^2 when compare to the males 23 ± 4 kg/m^2 ($P= 0.016$)²⁴. In this study BMI was found to be significantly greater in the females of Sindhi, Pathan and Punjabi.

BSA determines that total surface area of the body for many conditions it is the better clinical indicator then body weight as it less affected by body adipose mass. BSA is used in many medical measurements critically for calculating the drug doses and intravenous fluid administrations. In this study, BSA was observed to be greatest in Hazarah 1.8 ± 0.2 m^2 and smallest in Urdu speaking and Sindhi 1.7 ± 0.2 m^2 . Aslam et al reported mean BSA 1.68 ± 0.16 m^2 in males and 1.46 ± 0.15 m^2 in females of the Multan city Punjab¹⁸. Mean body surface area found among the Punjabi males and females of this study was 1.9 ± 0.02 m^2 and 1.66 ± 0.02 m^2 respectively and this difference was statistically significant ($P= 0.002$).

LBM which is commonly known as fat free mass was found to vary insignificantly among the ethnic groups ($P= 0.073$). To the best of our knowledge this is the first study that report LBM among the healthy adults in Pakistani population. In this study, it was found to be highest among the Hazarah 52.6 ± 9.6 kg and lowest in the Baloch 48.5 ± 3.4 kg. Among all the ethnic groups LBM was reported to be significantly greater in adult males as compare to the females ($P< 0001$).

This study gives the overview of anthropometric parameters of the ethnic groups of Karachi population. Unequal Volunteers in the ethnic groups is the limitations of this study. Other anthropometric parameters such as waist hip ratio, waste height ratio and head circumference would have also helped us in accurately determining the anthropometric parameters.

Determination of anthropometric parameters among the ethnic groups would help us to determine the disease risk factors specific for that ethnic group and would also help in prevention and treatment. In future detailed analysis of genetic and epigenetic factors controlling anthropometric traits

among the ethnic groups would give us detailed understanding of these variations. This in turn will improve our understanding to many diseases predominantly obesity and its associated diseases which is now epidemic and major health problem worldwide.

Conclusion

Variations in the anthropometric parameters among the populations very well documented, as numerous genetic and epigenetic factors are known to influence it. In this study anthropometric parameters noted among the ethnic groups in Karachi population were very close to the studies done in the different provinces of Pakistan. In all the ethnic groups BMI males were found to have significantly greater anthropometric parameters as compared to the females.

Conflict of Interest

There is no conflict of interest from the authors of this research

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Answer of Pictorial Quiz: Differential Diagnosis:

- " Irritation Fibroma
- " Verruciform Xanthoma
- " Schwannoma (Solitary Circumscribed Neuroma or Traumatic Neuroma)