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ANTHROPOMETRIC INDICES - A TOOL FOR SAFEGUARD ALERT TO OFFSPRING OF DIABETIC AND HYPERTENSIVE PARENTS

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ABSTRACT

Background: Family history represents the integration of shared genomic and environment risk factors. This suggests that family history might be a practical and useful way to target interventions and disease prevention efforts of the prone population. Anthropometry provides the single most portable, universally applicable, cost-effective and non-invasive technique for assessing the size, proportions and composition of the human body. Basic anthropometric measurements and their derived indices are used as indicators for the presence of diseases and their assessment in clinical practice. **Purpose:** Present work has been carried out to determine whether such abnormalities can be detected in healthy young adults with a family history of type 2 diabetes mellitus, hypertension at an early age that may presage the onset of these chronic diseases. **Methodology:** The study was conducted among 400 healthy adults (20-30 years of age). The derived indices were determined from the basic anthropometric measurements. **Results:** The various basic and derived anthropometric indices showed changes in healthy adult offspring from type 2 diabetes mellitus and hypertensive parents. **Conclusion:** All the derived anthropometric indices like BMI, WHR, WHtR reflect significantly increased value in young healthy adults (20-30yrs of age) having positive family history of both the chronic diseases type 2 diabetes mellitus and hypertension.

Key words: *Family history; type 2 diabetes mellitus; hypertension; derived anthropometric indices.*

INTRODUCTION

Type 2 Diabetes Mellitus has taken the shape of an epidemic causing a major public health burden in the 21st Century,[1] and one of the most common non-communicable diseases and the fifth major cause of death in the world.[2] Rapid urbanization and unprecedented economic growth in India has led to a shift in health problems from communicable to non-communicable diseases with diabetes and cardiovascular diseases leading the list of determinants of morbidity and mortality.[3,4] In recent years, anthropometric indicators have been repeatedly shown to be simple as well as powerful predictors of common adult chronic conditions in most of the populations studied.[5] Basic anthropometric measurements along with their derived indices are used as indicators for the presence of diseases and their assessment in clinical practice.[6-8] Family history represents the integration of shared genomic and environment risk factors for conception of these diseases. [9] However, the phenomenon of a link between family history and disease risk, needs to be supported by evidence based approaches to capture and use such information in therapeutics.[10,11] As per literature, being overweight is taken as a major risk factor for a plethora of chronic diseases like cardiovascular disease (CVD) as well as type II diabetes.[12] As per Indian Diabetic Federation (IDF) estimates, the global prevalence of type 2 diabetes mellitus (among 20-79 years old) would increase to 333 million by 2025 (World Health Organization (WHO)[2] and 366 million people by 2030.[13] The incidence of Diabetes Mellitus may be due to deficient insulin secretion, poor insulin function or both.[14] Diabetes mellitus is expected to continue as a major health problem owing to serious complications[15] including retinopathy, nephropathy, sexual dysfunction and cardiovascular disease, peripheral neuropathy and autonomic neuropathy.[16]

Cardiovascular diseases, particularly hypertension account for high mortality in western countries and stroke in countries like India, Taiwan and Japan.[17] Many of the risk factors associated with the development of hypertension are preventable. Social class, salt intake, parental history of hypertension, weight, height and body mass index have been reported to increase mean blood pressure and prevalence of hypertension.[18] The Global Burden of Disease Study has enumerated hypertension as a significant cause of death in the year 2020 reflecting that hypertension is an enormous health problem and a major health challenge of the 21st century.[19] Obesity is characterized by chronic imbalance between food intake and energy expenditure and WC and WHR have been used as measures of visceral obesity whereas BMI as general obesity measurement.[20] Another important factor is that overweight in adolescence predicts adverse health effects in adulthood.[21] The anthropometric protocols should be applied for their effect on everyday clinical practice and their contribution to improve the health status of patients. These evaluations should include assessment of both immediate and long term health benefits. As compared with more conventionally studied chronic

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conditions (e.g. type 2 diabetes mellitus and cardio-vascular diseases) this may improve faster when weight management is successful. [5] So this study of young adults of this geographical region, having a proven family history of type 2 diabetes mellitus and hyper-tension has been conducted with an aim to devise preventive measures to save them from the morbidity and mortality caused by these chronic diseases.

MATERIALS AND METHODS

The present study was conducted among 400 healthy adults (20-30 years of age) of Amritsar city (Punjab, India). In this study the following four groups were taken:-

Group I: Healthy adults with no family history of type 2 diabetes mellitus, hypertension.

Group II: Healthy adults with positive family history of type 2 diabetes mellitus.

Group III: Healthy adults with positive family history of hypertension.

Group IV: Healthy adults with positive family history of type 2 diabetes mellitus with hypertension.

One hundred healthy adults were recruited for each group. The subjects were selected from the general population residing in Amritsar city. An informed consent and relevant data was taken from them. The Plan of the study was approved by Baba Farid University of Health Sciences, Faridkot, Punjab vide letter no. BFUHS/2010/p-TH/12666 dated 23/11/10.

Anthropometric Measurements

All the measurements were done using standard methodology: -

A. Basic Anthropometric Measurements

1) Height:- Height was measured (to the nearest 0.1centimeter) with a steel anthropometric rod against a vertical scale of portable stadiometer and with the head positioned so that the top of the external auditory meatus is in level with the inferior margin of the bony orbit. [22]

2) Weight:- Weight (to the nearest 0.5kg) was recorded with the subject standing motionless on the weighing scale, barefooted wearing minimum clothes with ensured privacy. [22]

3) Circumferences: - The waist and hip circum-ferences in centimeters were measured with a measuring tape as per standard procedures. These circumferences were measured twice, to the nearest centimeter and the mean was used for subsequent analysis.
   i) Waist circumference (WC) was measured by using bone landmarks as references as per WHO guidelines. [5] Elevated WC was defined as WC=102cm for men and 88cm for women. [22]
   ii) Hip circumference (HC) was measured taken at the level of the greater trochanters in centimeters. [22]

B. Derived Anthropometric Indices

1) Body Mass Index (BMI):- BMI was calculated as per standard methods and conventional BMI cut off points were applied to classify the studied population into the following [22]:-
   i) BMI <18.5 Kg/m^2 taken as underweight
   ii) BMI > 18.5 - <25.0 Kg/m^2 taken as normal weight
   iii)BMI ⩾25.0 Kg/m^2 taken as over weight

2) Waist-Hip Ratio (WHR) was calculated using as :
   WHR = WC(cm) /HC(cm)
   Elevated WHR = 0.95 for men and 0.88 for women. [22]

3) Waist-Height Ratio (WHtR) or Waist-Stature Ratio (WSR) was calculated using:
   WHtR = WC(cm)/Height(cm)
   The 0.5 was taken as cut-off value for both genders (men & women). [23]

All the instruments were calibrated and verified before they were used. The evaluations were taken single handed by the investigator. The inclusion/exclusion criteria based on anthropometric indicies were not taken. The authors took four groups having 100 Healthy adults in each group because the sample size in each group should be minimum 100 in number. The study duration was two years.

Statistical analysis

The data of study was analyzed using Statistical Package for Social Sciences(SPSS). Mean, standard deviation, ANOVA Post Hoc Test and Pearson's Chi-Square (x^2) test were used to investigate the results and a conclusion was drawn. p" is the level of significance and its value < 0.05 is considered to be significant.

RESULTS

The study was conducted to assess the effect of family history of chronic diseases viz. type 2 diabetes mellitus and hypertension on basic and derived anthropometric indices in healthy adults. The derived data as presented below:

Table 1: *Basic Characteristics of the Studied Sample of 400 Healthy Adults*

Anthropometric and Physiological variables	Group I (n=100) Mean±SD	Group II (n=100) Mean±SD	Group III (n=100) Mean±SD	Group IV (n=100) Mean±SD
Age (Years)	22.06±1.98	22.02±2.47	22.11±2.44	23.38±2.96
Weight (Kg)	57.38±9.88	61.59±11.24	59.43±12.12	66.47±12.15
Height (cm)	165.96 ±8.12	163.51 ±7.96	161.84 ±8.37	165.12±8.24
Systolic Blood Pressure (mmHg)	111.42±11.04	113.90±9.25	114.82±11.67	118.48±12.08
Diastolic Blood Pressure (mmHg)	73.66±7.21	74.38±5.70	76.04 ±7.32	77.12 ±7.00
Hip Circumference (cm)	93.03±6.38	93.82±6.18	93.77±6.67	97.25±6.81
Waist Circumference (cm)	79.00±7.33	85.78±8.21	82.22±7.81	87.86±9.07
Body Mass Index (Kg/m^2)	20.76±2.68	23.01±3.68	22.61±3.65	24.30±3.58
Waist Hip Ratio	0.85±0.05	0.91±0.05	0.88±0.05	0.90±0.05
Waist Height Ratio	0.48±0.04	0.52±0.05	0.51±0.05	0.53±0.05

Table 2: *Comparison between groups according to Mean difference of Physiological and Anthropometric variables*

Physiological and Anthropometric variables	Comparison between groups	Mean difference	P value
Systolic Blood Pressure (mm of mercury)	Group I Vs Group II	2.480	0.388^{ns}
	Group I Vs Group III	3.400	0.133^{ns}
	Group I Vs Group IV	7.060	<0.001***
Diastolic Blood Pressure (mm of mercury)	Group I Vs Group II	0.720	0.879^{ns}
	Group I Vs Group III	2.380	0.068^{ns}
	Group I Vs Group IV	3.460	0.002**
Hip Circumference (cm)	Group I Vs Group II	0.790	0.827^{ns}
	Group I Vs Group II	0.740	0.853^{ns}
	Group I Vs Group IV	4.220	<0.001***
Waist Circumference (cm)	Group I Vs Group II	6.780	<0.001***
	Group I Vs Group II	3.220	0.027*
	Group I Vs Group IV	8.860	<0.001***
Body Mass Index (Kg/m^2)	Group I Vs Group II	2.249	<0.001***
	Group I Vs Group III	1.851	0.001**
	Group I Vs Group IV	3.540	<0.001***
Waist Hip Ratio	Group I Vs Group II	0.064	<0.001***
	Group I Vs Group III	0.027	0.001**
	Group I Vs Group IV	0.053	<0.001***
Waist Height Ratio (WHtR)	Group I Vs Group II	0.049	<0.001***
	Group I Vs Group III	0.032	<0.001***
	Group I Vs Group IV	0.056	<0.001***

NS; p > 0.05; Not Significant; *p < 0.05; Significant at 5% significance level;
p < 0.01; more Significant at 1% significance level; ***p < 0.001; Highly Significant

Mean difference calculated according to table 1 and on statistical analysis in table 2 it was observed that in all the basic and derived anthropometric indices group1 Vs group IV showed highly significant results (p<0.001).

Table 3: *Number of subjects with normal and elevated values of waist circumference (WC), waist hip ratio (WHR) & waist height ratio (WHtR)*

Anthropometric variables		Normal Values	Elevated Values
WC	Gp I	93	07
	Gp II	80	20
	Gp III	88	12
	Gp IV	69	31
WHR	Gp I	88	12
	Gp II	47	53
	Gp III	72	28
	Gp IV	58	42
WHtR	Gp I	74	26
	Gp II	34	66
	Gp III	51	49
	Gp IV	26	74

Table 3 shows that in the studied sample, elevated WC was maximum in group IV and minimum in group I. Number of cases with elevated WHR was maximum in group II and minimum in group I. It was observed that number of cases with elevated WHtR was maximum in group IV and minimum in group I.

Table 4: *Classification of the Subjects According to Body Mass Index (BMI)*

BMI	Group I	Group II	Group III	Group IV
Underweight	21	9	11	6
Normal	72	61	58	50
Overweight	7	30	31	44
Total	100	100	100	100

In table 4 it is observed that number of overweight cases was maximum in group IV and minimum in group I. Number of underweight cases was maximum in group I and minimum in group IV.

Table 5: *Statistical comparison of the number of subjects for derived anthropometric indices using Pearson Chi Square(x^2) test*

Anthropometric variables	Comparison between groups	Chi-Square (x^2)	P Value
WC	Group I Vs Group II	7.236	0.007**
	Group I Vs Group III	1.454	0.228^{NS}
	Group I Vs Group IV	18.713	<0.001***
WHR	Group I Vs Group II	38.313	<0.001***
	Group I Vs Group II	8.000	0.005**
	Group I Vs Group IV	22.831	<0.001***
WHtR	Group I Vs Group II	32.206	<0.001***
	Group I Vs Group III	11.285	0.001**
	Group I Vs Group IV	46.080	<0.001***
BMI	Group I Vs Group II	20.007	<0.001***
	Group I Vs Group III	19.791	<0.001***
	Group I Vs Group IV	39.144	<0.001***

NS; p > 0.05; Not Significant; *p < 0.05; Significant at 5% significance level;
p < 0.01; more Significant at 1% significance level; ***p < 0.001; Highly Significant

In table 5 on statistical analysis it was observed that increase in the number of cases with all the elevated anthropometric indices was highly significant between group I Vs group IV.

DISCUSSION

Prevalence of obesity has increased markedly over recent decades due to changing food habits and increased sedentary lifestyles.[24] Prospective epidemiological studies have shown increased abdominal fat accumulation to be an independent risk factor for type 2 diabetes mellitus and hypertension.[25] In the present study, 400 healthy adults (20-30 years of age) were taken in four groups to compare the various anthropometric indices. These results indicated that healthy adults in whom the family history of both type 2 DM and hypertension was present showed highly significant increase of hip circumference than those healthy adults whose parents were either diabetic, hypertensive or none (table 2). Increased HC is not a first-rate indicator for the onset of these chronic diseases.[16] A large HC has been associated with lower cardiovascular disease risk in some studies.[26,27]

As per Table 3 results showed that the healthy adults having family history of type 2 DM or both type 2 DM and hypertension had highly significant increase of waist circumference than those healthy adults having negative family history of these chronic diseases. Our study is corroborative with the Bogalusa Heart Study of Caucasian and a study done in Italy in which the offspring of type 2 diabetes mellitus parents had significantly higher WC than in those of non-diabetic parents.[21,28] It is observed that increase of WC was also an important indicator. The people of South Asian origin have increased cardiovascular risk due to more centralized deposition of body fat with higher mean of WC and WHR.[29]

As per table 5 it is shown that the cases of elevated WC were maximum among healthy adults having positive family history of type 2 DM and hypertension. This study is corroborative with a study done in Mexican Americans,[22] the San Antonio Heart study,[30] Framingham Heart study,[31] the Bogalusa Heart Study,[28] a cross-sectional epidemiological study in Asian population.[32] Body Mass Index (Kg/m^2) showed that healthy adults having positive family history of type 2 DM and hypertension have maximum BMI than those having either positive family history of type 2 DM, hypertension alone or negative family history of these diseases. Our study is corroborative with the San Antonio Heart study in Mexican Americans and non-Hispanic whites,[30] the Bogalusa Heart Study[28] and study of primary school children in Italy.[21] According to WHO, BMI $\geqslant$ 25.0 Kg/m^2 were overweight cases, and our study showed that percentage of overweight cases were maximum in healthy adults with positive family history of both the chronic diseases viz type 2 DM and hypertension than a family history of single chronic disease, whereas the overweight cases were minimum, having negative family history of these chronic diseases.

The maximum value of WHR was seen in healthy adults with positive family history of type 2 DM and minimum in healthy adults having negative family history of both these chronic diseases.(table 2) Our study is consistent with the Bogalusa Heart Study,[28] a cross-sectional epidemiological study in Asian population,[32] the study of African Americans[16] showing that WHR is the best predictor for type 2 DM .The number of cases of increase WHR from the cut off values was more in healthy adults in whom the family history of type 2 DM or both the chronic diseases viz type 2 DM and hypertension than those healthy adults having negative family history of

these chronic diseases (table 3). It was seen that mean values of WHtR was maximum in healthy adults having positive family history of both the chronic diseases viz. type 2 DM and hypertension and minimum in those having negative family history of these chronic diseases. Our present study is corroborative with various international studies [33, 34, 23] in which also WHtR predicts the risk for chronic diseases viz. type 2 DM and hypertension.

CONCLUSION

The various basic and derived anthropometric indices showed changes in healthy adult offspring of the parents having type 2 diabetes and hypertension. BMI, WC, WHR and WHtR which are the important anthropometric indices gave inferences by showing increasing values in predicting the onset of these chronic diseases in healthy adults in their later life if family history happened to be positive. They should be advised to do regular exercise to control their weight, avoid obesity, to abstain from taking junk and oily food and motivated for regular monitoring of their blood sugar and blood pressure. This study mainly reflected that anthropometric indices could be used as a tool for safeguard alert to offspring of diabetic and hypertensive parents.

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