ORIGINAL ARTICLE

Correlation between anthropometry and lipid profile in healthy subjects of Eastern India

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ABSTRACT

Background: Cardiovascular diseases constitute one class of common contributors to morbidity and mortality worldwide. Prevalence of overweight and obesity has dramatically increased in developing countries and is related to cardiovascular risk factors. Anthropometric parameters have the advantages in daily clinical practice of being a simple to measure tool with good reproducibility, especially in a developing country like India. Aim of this study is to correlate some anthropometric variables with lipid parameters in healthy subjects and to assess the anthropometric variable which best reflects the altered lipid profile.
Materials and Methods: A hospital based cross-sectional study was conducted after the Institutional Ethical Committee Clearance. Included participants (1187) were subjected to anthropometric measurements such as height, weight, waist circumference (WC), and hip circumference using standard procedures on the same morning of the day, as the blood sample was collected after overnight fast and estimated for fasting blood sugar and lipid profile.
Results: There is a weak correlation between body mass index (BMI) and lipid parameters. Among all the anthropometric variables studied, WC is best correlated to lipid parameters. The mean values of lipid parameters were not significantly different in BMI <25 and BMI ≥25 groups.
Conclusions: WC remains one of the simple and reliable variables which best reflects the lipid profile. In a developing country like India, where measurement of cardiovascular risk factors such as body fat saturation and lipid profile remains difficult in the rural population, WC may be used as an effective tool, without being used as a substitute.

Key Words: Body mass index, Eastern India, lipid profile waist circumference

INTRODUCTION

Cardiovascular diseases (CVD) constitute one class of common contributors to morbidity and mortality worldwide.[1] Of the many risk factors for the development of CVD, age, gender, family history and genetic inheritance are un-modifiable,[2] while smoking, physical inactivity, poor diet, obesity, and dyslipidemia are modifiable.[3] Prevalence of overweight and obesity has dramatically increased in developing countries and is related to cardiovascular risk factors.[4] According to World Health Organization, in 2008, more than 1.4 billion adults were overweight. Of these over 200 million men and nearly 300 million women were obese.[5] Studies show excess adipose tissue, mostly central, is associated with high cardiovascular morbidity

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and mortality.[6] Diverse methods have been used to assess the amount and the distribution of body fat and its relationship to CVD. Anthropometric parameters, such as body mass index (BMI), waist circumference (WC) and waist-to-hip ratio (WHR), have the advantages in the daily clinical practice of being simple to measure with good reproducibility,[7] especially in a developing country like India. Though BMI reflects lean mass and fat, it scarcely identifies the distribution of the latter.[8] Rather, other anthropometric indices, such as WC, waist-to-height ratio, and WHR, have been used as alternatives to BMI. WC is being increasingly accepted as the best anthropometric indicator of abdominal adiposity and metabolic risk.[9] It is less known, however, which one of these anthropometric variables (BMI or WHR or WC) is a better link to lipid profile.

Some of the previous studies reported internationally show there is a significant correlation between afore-mentioned anthropometric variables and lipid parameters,[10-12] while others opine there are no such statistically significant correlations.[6,13] Many Indian studies have been reported relating anthropometric parameters with lipid profile in type 2 diabetes[14] and also in hypothyroid patients.[15] Not many studies have been reported in this regard involving healthy subjects in India,[9] especially in Eastern India. The present study attempts to correlate some anthropometric variables with lipid parameters in apparently healthy subjects, as also to assess the anthropometric variable which best reflects the altered lipid profile.

MATERIALS AND METHODS

This is a hospital based, single centered, cross-sectional study conducted at a private hospital after permission from Institutional Ethical Committee during the period from September 2012 to August 2013. Consenting participants, with apparent cardio-metabolic healthy disposition, between 18 and 65 years of age were included in the study. All subjects with history of diabetes mellitus, CVD, carcinoma, liver diseases, renal diseases, and subjects on lipid-lowering agents were excluded from the study.

Of the 2500 consenting participants, 1313 were excluded due to the presence of one or more exclusion criteria after a detailed history and physical examination. The included participants (1187) were subjected to anthropometric measurements such as height (ht), weight (wt), WC, and hip circumference (HC) using standard procedures[16] on the same morning of the day as the blood sample was collected.

Height was measured in centimeters, without shoes, with a standard height measuring rod; weight was measured in kilograms (kg), without shoes, using digital scales and was recorded to the accuracy of 0.1 kg. WC was measured using a measuring tape for each participant with minimal clothing and with feet about 25-30 cm apart; measurements were taken in a plane perpendicular to the long axis of the body at the level of umbilicus without compressing the skin. HC was similarly measured across the greater trochanter with legs and feet together.

BMI and WHR were computed. BMI was calculated as weight in kilograms divided by height in meters square. Those with BMI of <25 were considered normal. Those with a BMI of 25.0-29.9 kg/m^2 were classified as overweight, whereas those with a BMI ≥30 kg/m^2 were defined as obese.[17] WHR was derived from the ratio of WC/HC.

Blood samples were drawn by a trained phlebotomist in the morning from all study participants after 12 h of overnight fasting. Blood samples were taken in a sitting position according to the standard protocol and were centrifuged within 30-45 min of collection. Fasting plasma glucose was estimated using glucose oxidase-peroxidase method.[15]

Lipid parameters such as (total cholesterol [TC], triglyceride [TG], low-density lipoprotein [LDL] cholesterol, very LDL [VLDL] and high-density lipoprotein [HDL] cholesterol) were estimated by a standard enzymatic method using Hitachi 902 auto-analyser. Reagents of Roche Diagnostics (Germany) were used.

Statistical analysis was done using Statistical Package for the Social Sciences (version 16, SPSS Inc., Chicago IL, USA). Data were expressed in mean. All participants were grouped into two groups according to BMI <25 and BMI ≥25. Unpaired *t*-test was done to compare between BMI variable groups. Pearson correlation of anthropometric variables with each lipid parameter was done and represented by the correlation coefficient (r); $P < 0.05$ was considered statistically significant.

RESULTS

Of the 1187 participants (637 males and 550 females), two groups were made according to the above-mentioned BMI cut-off points. The mean BMI of both the groups is 22.36 ± 2.02 and 28.05 ± 3.2, respectively. Table 1 shows that the mean values of lipid parameters were not significantly different in both the groups.

Table 2 shows the weak correlation between BMI and lipid parameters. WC is best correlated to lipid parameters.

Furthermore, the correlation of BMI with lipid parameters in the BMI <25 group was weak and insignificant; in the BMI ≥25 group BMI showed a significantly negative correlation with HDL ($r = -0.3$, $P = 0.03$).

Table 1: Comparative data on the mean values of lipid parameters of both the groups with their significance

BMI groups	TC	TG	LDL	VLDL	HDL	LDL/HDL
BMI <25 (578)	175.5	137.0	102.3	28.66	44.83	2.28
BMI ≥25 (609)	184.7	148.7	109.3	29.67	44.67	2.25
P	0.15	0.28	0.24	0.62	0.91	

BMI: Body mass index, TC: Total cholesterol, TG: Triglyceride, LDL: Low-density lipoprotein, VLDL: Very low-density lipoprotein, HDL: High-density lipoprotein

Table 2: Correlation of anthropometric variables with lipid parameters

Variables	TC	TG	LDL	VLDL	HDL
BMI	−0.05	0.04	−0.02	0.08	−0.106
WC	0.25	0.44*	0.35	0.51	−0.62*
WHR	0.22	0.31	0.15	0.18	−0.24*

**P*<0.05. BMI: Body mass index, TC: Total cholesterol, TG: Triglyceride, LDL: Low-density lipoprotein, VLDL: Very low-density lipoprotein, HDL: High-density lipoprotein, WC: Waist circumference, WHR: Waist-to-hip ratio

Table 3: Comparative data on the mean values of lipid parameters for both the groups in males and females

Parameters	Males			Females		
	BMI <25	BMI ≥25	*P*	BMI <25	BMI ≥25	*P*
TC	176.2	176.3	0.55	173.6	190.1	0.6
TG	141.4	154.3	0.18	125.4	136.2	0.17
LDL	102.1	106.6	0.88	103.0	114.9	0.59
VLDL	30.0	30.7	0.99	24.9	27.4	0.11
HDL	44.2	43.3	0.12	46.5	47.6	0.015*
LDL/HDL	2.31	2.46		2.21	2.41	

*Statistically significant. TC: Total cholesterol, TG: Triglyceride, LDL: Low-density lipoprotein, VLDL: Very low-density lipoprotein, HDL: High-density lipoprotein, BMI: Body mass index

Table 4: Comparison of anthropometric and lipid variables between the younger and the older age groups

Variables	Age <40 years(590)	Age ≥40 years (597)	*P*
Age (years)	31.5	58.4	0.000*
TC	173.7	184.2	0.37
TG	132.7	149.3	0.032*
LDL	105.6	106.1	0.53
VLDL	27.2	30.4	0.048*
HDL	45.0	44.3	0.368
BMI	24.7	25.2	0.908
WC	79.4	82.7	0.007*
WHR	0.89	0.92	0.460

*Statistically significant. TC: Total cholesterol, TG: Triglyceride, LDL: Low-density lipoprotein, VLDL: Very low-density lipoprotein, HDL: High-density lipoprotein, BMI: Body mass index, WC: Waist circumference, WHR: Waist-to-hip ratio

A glance at Table 3 shows that none of the lipid parameters was significantly different in both BMI groups among the males. HDL cholesterol was significantly different in aforementioned groups among the females.

Though the BMI was not significantly different in both the age groups, there was a significantly greater WC in the older group than the younger group. Each of TG and VLDL was significantly greater in the older age group than the younger group [Table 4].

Table 5 makes a comparison of anthropometric and lipid variables between the genders of younger and older age groups chosen. In the younger age group, the mean values of lipid and anthropometric variables were generally higher for the males than the females; mean values of TC, TG and LDL were significantly higher. For both the genders, the mean values of all variables were higher in the older age group than the younger age group. However, in the older age group the difference in the mean values of VLDL, WC and WHR were significant between the genders.

DISCUSSION

Anthropometric parameters are commonly used as research tools to assess the risk factors for noncommunicable diseases in a population. For several decades, dyslipidemia has been found as one of the risk factors for various noncommunicable diseases such as diabetes, hypertension, and many other CVD.[18] The present study makes an attempt to evaluate the correlation between anthropometric variables with lipid parameters, in order to determine which of the former can commonly be used in clinical practice and epidemiological studies as the best link to the altered lipid profile.

While a South Indian pilot study reports a strong correlation between anthropometric parameters and lipid profile in healthy adults,[9] the present study shows no correlation between BMI and lipid profile; in the BMI ≥25 group, BMI showed significant negative correlation with HDL. Results of a few other studies support our findings.[6,19-21]

In the present study, among the anthropometric variables, WC was best correlated with TG (positively) and HDL (negatively). There was no significant difference in lipid profile among the two BMI groups in males and females; in contrast, the Brazilian study[6] reports gender differences influencing the association between lipid parameters and anthropometric variables.

The main nonmodifiable risk factor for CVD is age; vascular endothelial damage becomes more apparent from

Table 5: Comparison of anthropometric and lipid variables between males and females of younger and the older age groups

Variables	Age <40 years (590)			Age ≥40 years (597)		
	Males (333)	Females (257)	*P*	Males (304)	Females (293)	*P*
TC (mg/dL)	178.4	170.1	0.04*	185.3	183.2	0.40
TG (mg/dL)	135.9	130.2	0.04*	147.1	151.2	0.10
LDL (mg/dL)	107.0	103.7	0.04*	105.1	106.8	0.37
VLDL (mg/dL)	28.2	26.9	0.06	31.2	29.4	0.03*
HDL (mg/dL)	45.6	44.8	0.45	44.8	43.8	0.21
BMI	24.9	24.5	0.09	24.9	25.4	0.10
WC (cm)	80.3	78.6	0.95	81.3	83.7	0.04*
WHR	0.91	0.88	0.07	0.95	0.90	0.0002*
Age in years	32.2	30.8	0.06	59.6	57.4	0.09

*Statistically significant. TC: Total cholesterol, TG: Triglyceride, LDL: Low-density lipoprotein, VLDL: Very low-density lipoprotein, HDL: High-density lipoprotein, BMI: Body mass index, WC: Waist circumference, WHR: Waist-to-hip ratio

the third decade of life and its clinical consequences begin around the age of about 40 years.[22] So in the present study we have grouped all participants into two age groups with a cut-off value of age 40 years. The mean values of WC, TG, and VLDL are significantly higher in the older age group. A previous study reports abdominal obesity has a greater effect on VLDL and TG levels than on other lipid parameters.[23] In this study, as the older age group reports to have a higher mean WC, that may have affected the mean VLDL and TG levels.

Variations of lipid and of anthropometric parameters in males and females, for younger and older age groups, give us an insight into interesting observations. Among the lipid variables, there was a significant difference in TC, TG, and LDL values between the genders (viz., males having higher values than the females) of the younger age group which was not observed in the older age group. On the other aspect, anthropometric variables such as WC and WHR were found to be significantly higher for females than for males in the older age group.[6]

In the present study, the mean age of females in the older age group is 57 years indicating most of them would have attained menopause. In the older age group, the gender differences in lipid parameters were not seen which may be due to increase in lipid parameters in menopausal females due to loss of protective estrogen effect and age-related changes in anthropometric variables such as WC and WHR.[24]

There are other drugs which may affect the lipid parameters. Such participants on those drugs have not been excluded in this study. Moreover, participants from one single center have been considered in this study which is also a limitation. Further probes involving a larger randomized community-based population may corroborate the contention.

CONCLUSION

Although it is difficult to conclusively interpret the present set of data, several meaningful inferences may however be drawn. Not all studied anthropometric variables correlate with the lipid status of the body, but WC remains one of the simple and reliable variables which best reflects the lipid profile. In a developing country like India, where measurement of cardiovascular risk factors such as body fat saturation and lipid profile remains difficult in the rural population, WC may be used as an effective tool, without being used as a substitute. Gender differences were not seen between anthropometric variables and lipid profile. Thus, both genders, especially in older age group, may be at equal risk of developing dyslipidemia.

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Conflicts of interest

There are no conflicts of interest.

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