ISSN: 0976-3031

Available Online at http://www.recentscientific.com

International Journal of Recent Scientific Research
Vol. 6, Issue, 7, pp.5103-5106, July, 2015

International Journal of Recent Scientific Research

RESEARCH ARTICLE

OVERWEIGHT AND OBESITY IN RELATION TO LIPID PROFILE AMONG MEDICAL STUDENTS IN KOLKATA, INDIA

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ARTICLE INFO

Article History:

Received 5th, June, 2015
Received in revised form 12th, June, 2015
Accepted 6th, July, 2015
Published online 28th, July, 2015

Key words:

medical students, anthropometric measurements, lipid profile, CVD risk.

ABSTRACT

Introduction: Overweight and obesity are well recognized as "escalating epidemic" in both developed and developing countries. Obesity can cause many health related problems, like CVD. Both obesity and serum lipids are modifiable factors for CVD. Serum lipid profile of young medical students in Kolkata was estimated to determine their CVD risk.
Method: The study was designed as a cross-sectional study. 200 randomly selected medical students were enrolled. Anthropometric measurements were taken. Serum lipid levels were estimated in a 12 hour fasting blood sample. Student's t-test was done to analyze the quantitative data and p value determined. Stepwise linear regression techniques were applied to assess the extent to which CVD risk factors depend on the obesity indices considered using the same independent variables. $p < 0.05$ was used to indicate statistical significance in all analyses.
Result: in this study, a substantial proportion of young medical students were found to be overweight. A high prevalence of high TG, high LDLC and low HDLC was seen. BMI was found as an useful index for dyslipidemia in males. WC was a strong determinant of TC and LDLC in females, while WHtR was a strong index for TC in males and all lipid parameters in females except HDLC which was best predicted by WHpR.

INTRODUCTION

Overweight and obesity are well recognized as "escalating epidemic" in both developed and developing countries (1, 2). Obesity in children and adolescents is gradually becoming a major public health problem in India (3). Five percent of total population of India has been affected by obesity (4).

Obesity and its associated morbidities are leading causes of several health problems, like cardiovascular disease (CVD), type-2 diabetes and some types of cancer (5). CVD in developing countries are characterized by early age of onset and greater mortality (6).

Both obesity and serum lipids are modifiable factors for CVD. Serum cholesterol consistently has been shown to be a significant risk factor for coronary heart disease and CVD (7, 8,9,10,11). A serum cholesterol level greater than 200 mg/dl or a fasting triglyceride level more than 150 mg/dl is associated with an increased incidence of coronary artery disease (12).

Cardiovascular risk factors have been studied in the younger populations – children, adolescents and youth in many high income group countries of North America, Europe and Australasia (13, 14, 15, 16). Young subjects have not been well studied from low income countries like, India and Pakistan.

The aim of this study was to determine the relationship between serum lipids to different obesity parameters in medical students in Kolkata, India.

METHODS

The study was designed as a cross-sectional study.

Approval of the Institutional Ethics Committee was obtained before undertaking the study.

Between the years 2008-2009, 200 randomly selected medical students having their age group between 19 to 23 years served as volunteers. Standing body height (BH) was measured to the nearest of 0.1 cm with the help of a wall mounted graduated wooden scale (17), fitted with an adjustable horizontal bar to fit over the cranial vault. Readings were taken from the level of the lowest point of the subject's heel to the height of the undersurface of the horizontal bar.

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Body weight (BW) was measured to the nearest of 0.1 kg with the help of a digital scale (17). Readings were taken from the '0' (zero) reference point.

Abdominal (waist) circumference (WC) was measured in centimeter at the level of umbilicus in supine posture (according to WHO guidelines) (18).

Hip circumference (HC) was measured at inter-trochanteric level while standing (18).

Body mass index (BMI) was calculated from height and weight thus obtained using the formula of Quetlet's index [weight (kg)/ height2 (m)]. According to BMI, the subjects were divided into three groups: subjects with BMI up to 22.99 kg/m2 were taken as normal, BMI >23 kg/m2 but <25 kg/m2 as overweight and BMI ≥25 kg/m2 as obese (19,20).

WC was divided by HC and BH in order to calculate the waist-to-hip (WHpR) and waist-to-height (WHtR) ratio respectively. Cut-off value for WC in males was ≥90 cm and in females it was ≥80 cm (21,22). For WHpR the cut-off value for males was ≥0.9 and in females it was ≥0.8 (21). The cut-off value for WHtR was ≥50 in both sexes (23).

Early morning, venous blood samples were drawn for biochemical tests, following a 12-hour overnight fast. Serum total cholesterol (TC), high density lipoprotein (HDL-C), low density lipoprotein (LDL-C) and triglyceride (TG) was estimated. TC and HDL-C was estimated by Cholesterol oxidase peroxidase (CHOD/POD) phosphotungstate method. TG was estimated by Glycerophosphate oxidase phenol 4-amino antipyrine peroxidase method. LDL-C was indirectly calculated from TC, HDL-C and TG levels.

Statistical analyses were done using the Statcalc version 5.0.4 licensed software. Student's t-test was done to analyze the quantitative data and p value determined. Stepwise linear regression techniques were applied to assess the extent to which CVD risk factors depend on the obesity indices considered using the same independent variables. $p < 0.05$ was used to indicate statistical significance in all analyses.

RESULTS AND ANALYSIS

Table 1

	Sex distribution	
	Total No. (n)	Percentage
Male	120	60
Female	80	40

In these studies 60% students were male and 40% students are female (Table 1).

18% male students are overweight and 19% are obese where as in females the values stand at 23% for both overweight and obese. In respect to WC, 30% males and 45% females were overweight. In respect to WHpR, 69% males and 72% females were overweight. In respect to WHtR, it was found that 38% males and 45% females are overweight.

Table 2 Prevalence of dyslipidemia in males and females:

	Male	Female
TC(>200mg%)	0% (n=0)	0%(n=0)
LDL-C (>100mg%)	15.83%(n=19)	11.25%(n=9)
HDL-C(<40mg%- M,<50mg%-F)	0.83%(n=1)	66.25%(n=53)
TG(>150mg%)	51.66%(n=62)	53.75%(n=43)

Table 2 shows hypertriglyceridemia was found in more than 50% cases in both sexes while reduced HDL-C level was seen in 66.25% females. 15.83% males showed a raised HDL-C level.

Table 3A Distribution of biochemical parameters in relation to BMI in males

	Normal	Overweight	p value	obese	p value
TC	139.4±4.1	149.9±7.24	<0.0001	169.5±8.08	<0.0001
LDLC	67.89±5.79	85.14±9.54	<0.0001	106.8±8.08	<0.0001
HDLC	49.53±4.41	42.77±3.74	<0.0001	40.7±1.01	<0.0001
TG	144.9±8.07	155±11.05	<0.0001	166.7±6.37	<0.0001

Table 3B Distribution of biochemical parameters in relation to BMI in females

	Normal	Overweight	p value	obese	p value
TC	138.5±4.28	146.8±4.21	<0.0001	164.2±8.1	<0.0001
LDLC	65.66±4.38	81.41±6.1	<0.0001	101.9±8.15	<0.0001
HDLC	50.89±3.14	43.38±2.75	<0.0001	40.33±0.9	<0.0001
TG	143.7±9.94	159.6±8.81	<0.0001	167±4.53	<0.0001

All variables like TC, LDLC, HDLC and TG were found significantly higher in both overweight and obese group in both sexes (Table 3A and 3B).

Table 4A Distribution of biochemical parameters in relation to WC in males

	Normal	Overweight	p value
TC	141.1±7.1	161.2±12.7	<0.0001
LDLC	70.2±9.7	97.9±13.7	<0.0001
HDLC	48.9±4.9	41.3±1.9	<0.0001
TG	144.9±7.9	165±7	<0.0001

Table 4B Distribution of biochemical parameters in relation to WC in females

	Normal	Overweight	p value
TC	139.3±4.85	154.5±11.95	<0.0001
LDLC	67.02±5.64	89.96±15.03	<0.0001
HDLC	50.29±3.44	42.58±4.07	<0.0001
TG	143.3±8.71	163.8±8.45	<0.0001

Table 4A and 4B show significant changes in all variables in relation to WC in both sexes.

Table 5A Distribution of biochemical parameters in relation to WHpR in males

	Normal	Overweight	p value
TC	140.1±4.3	150.2±14.29	<0.0001
LDLC	68.18±6.4	83.12±17.98	<0.0001
HDLC	49.96±4.77	45.1±5.06	<0.0001
TG	143.9±9.06	154±11.85	<0.0001

Table 5B Distribution of biochemical parameters in relation to WHpR in females

	Normal	Overweight	p value
TC	140.2±5.16	148.4±12.54	<0.004
LDLC	67.25±5.41	81.17±16.75	<0.0001
HDLC	50.93±3.34	45.26±5.16	<0.0001
TG	141.6±8.27	156.7±12.54	<0.0001

Table 5A and 5B showed significant change in all variables in males and females except TC in overweight females.

Table 6A Distribution of biochemical parameters in relation to WHtR in males

	Normal	Overweight	p value
TC	140.32±6.2	158.44±13.42	<0.0001
LDLC	68. 95±8.56	94.46±15.05	<0.0001
HDLC	49.37±4.75	41.98±2.67	<0.0001
TG	145.4±8.57	160.1±11.24	<0.0001

Table 6B Distribution of biochemical parameters in relation to WHtR in females

	Normal	Overweight	p value
TC	139.7±5.56	154.1±12.18	<0.0001
LDLC	67.66±7.27	89.18±15.36	<0.0001
HDLC	50.04±3.88	42.89±4.15	<0.0001
TG	144.9±11.18	161.1±9.16	<0.0001

According to Tables 6A and 6B all the variables showed significant change in overweight group when WHtR was taken into account.

Table 7A Regression analysis of lipid profile in relation to obesity indices in males.

Obesity index	Dependent variables	Y Intercept (a)	Slope (b)	Pearson R	R2	p value (<)
BMI	TC	10.707	0.09	0.596	0.355	**0.0001**
	LDLC	16.891	0.088	0.769	0.591	**0.0001**
	HDLC	34.578	-0.225	-0.403	0.162	0.006
	TG	9.328	0.099	0.077	0.593	**0.0001**
WC	TC	71.9407	0.1341	0.49	0.2401	0.002
	LDLC	81.5501	0.1226	0.483	0.2333	0.003
	HDLC	108.6507	-0.3653	-0.203	0.0412	0.235
	TG	83.7911	0.0592	0.119	0.0142	0.488
WHpR	TC	0.8502	0.0007	0.311	0.0967	0.004
	LDLC	0.9118	0.0006	0.319	0.1018	0.003
	HDLC	1.0411	-0.0017	-0.256	0.0655	0.02
	TG	0.8162	0.0009	0.327	0.1069	0.003
WHtR	TC	0.3119	0.0015	0.533	0.2841	**0.0001**
	LDLC	0.1683	0.0035	-1	0.0	1.0
	HDLC	-0.0123	0.0139	-1	0.0	1.0
	TG	-1.7942	0.0139	-1	0.0	1.0

Table 7B Regression analysis of lipid profile in relation to obesity indices in females.

Obesity index	Dependent variables	Y Intercept (a)	Slope (b)	Pearson R	R2	p value (<)
BMI	TC	-1.7840	0.1751	0.831	0.6906	0.0001
	LDLC	11.4909	0.1523	0.835	0.6972	0.0001
	HDLC	46.9854	-0.5146	-0.571	0.326	0.0001
	TG	4.7274	0.1268	0.435	0.1892	0.008
WC	TC	49.9522	0.2178	0.702	0.4928	0.0001
	LDLC	68.6328	0.1666	0.675	0.4556	0.0001
	HDLC	100.4121	-0.3944	-0.432	0.1866	0.009
	TG	61.9095	0.1326	0.302	0.0912	0.074
WHpR	TC	0.6854	0.0012	0.357	0.1274	0.006
	LDLC	0.7781	0.001	0.405	0.164	0.002
	HDLC	1.0195	-0.0036	-0.448	0.2007	0.0001
	TG	0.6751	0.0012	0.359	0.1289	0.006
WHtR	TC	22.9741	0.2053	0.748	0.5595	0.0001
	LDLC	40.0003	0.1638	0.753	0.5670	0.0001
	HDLC	75.0706	-0.4771	-0.593	0.3516	0.0001
	TG	31.2814	0.1441	0.395	0.156	0.017

Tables 7A and 7B show different obesity indices that can best predict abnormal lipid profile in males and females respectively.

DISCUSSION

In our study, the percentage of male students with BMI ≥ 25 kg/m2 was found to be 19% while in females it was 23%. Bertsias G *et al* (2003) also found 23% females with BMI ≥ 25 kg/m2 but in males the incidence was 40% (24). Gupta R *et al* (2009) found a much lower prevalence of overweight adolescents in Indian urban population (7.6% in males and 8.8% in females) (25). This difference can be attributed to the fact that their study involved a huge sample size. In this study, central obesity pattern in males was found to be 69% considering WHpR while it was 72% in females. According to WHtR, males showed overweight of 45% and females showed 38% overweight. These figures were much greater when compared to BMI values. Dudeja V *et al* (2001) have reported that BMI does not actually predict overweight in Asian Indians (26). So WHpR and WHtR were involves to study truncal obesity. Gupta R *et al* (2009) have found that truncal obesity has strong association with CVD in the Indian population (25). In this study, total serum cholesterol value >200 mg% was not found amongst any of the students but prevalence of hypertriglyceridemia was very high in both sexes (~50%). Also LDLC was as high as 15.83% in males and 11.25% in females. Decreased HDLC level was seen in 66.25% females. Morar N *et al* (1998) have reported hypercholesterolemia in 19.4% students and high LDLC in 16.9% students (27). Farris R *et al* (1994) have shown prevalence of high TC in 18% males and 31% females at Louisiana State University (28).

In our study, TC values were not above 200mg% in any of the students, but when a comparison was done between the normal and overweight groups, it was found to be significantly higher in overweight groups in both sexes. There was a significant rise in LDLC and TG in overweight males, but in females, high WHpR did not show a significant increase in TC, while all other obesity indices showed significant rise I lipid profile, compared to normal. There was also significant fall in HDLC in both sexes who were overweight. These results corroborate with the findings of Bertsia G *et al* (24) and Gupta R *et al* (25). So this study suggests that the influence of obesity on cardiovascular risk factors begins in early adulthood and overweight during adolescence is associated with increased risk of CHD in both males and females.

Prediction of dyslipidemia using obesity indices was done by linear regression analysis (Tables 7A and 7B). This showed that in males BMI was the best obesity index for predicting TC, LDLC and TG with p value <0.0001 while WC and WHpR were not significant determinant of any of the variables. WHtR was a good predictor for TC. In females however BMI and WHtR were found to be a strong predictor of TC, LDLC and HDLC. WC showed significant prediction for TC and LDLC. WHpR is also significant for HDLC. This finding was consistent with that of Bertsias G *et al* (24) who reported that in females, WHtR is the best index for LDLC, WC for TG and HDLC and WHpR for HDLC.

CONCLUSION

The prevalence of coronary risk factors has been very inadequately studied in India, particularly in West Bengal. Hence this study was planned to assess the lipid profile amongst the first year medical students and to correlate it with the different obesity indices.

In our study we found

1. Substantial proportion of young medical students were overweight.
2. A high prevalence of high TG, high LDLC and low HDLC.
3. BMI was an useful index for dyslipidemia in males.
4. WC was a strong determinant of TC and LDLC in females.
5. WHtR was a strong index for TC in males and all lipid parameters in females except HDLC which was best predicted by WHpR.

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