National Journal of Physiology, Pharmacy and Pharmacology

RESEARCH ARTICLE

Body mass index an early indicator of abnormal glucose and lipid profiles in young Indian adults

Indu K Pisharody[1], Neelam Bala Prasad[2]

[1]Department of Physiology, Career Institute of Medical Sciences and Hospital, Lucknow, Uttar Pradesh, India, [2]Department of Physiology, Padmashree Dr. D. Y. Patil Medical College and Research Center, Pimpri, Pune, Maharashtra, India

Correspondence to: Indu K Pisharody, E-mail: anayathsib@yahoo.com

Received: December 10, 2017; **Accepted:** December 30, 2017

ABSTRACT

Background: The worldwide prevalence of obesity has more than doubled since 1980. Obesity is rapidly becoming a major medical and public health problem. Body mass index (BMI) is an important indicator of overweight and obesity in childhood, adolescence, and young adults. Early detection of prospective obesity and its intervention in young age group would be of particular significance to prevent obesity-associated comorbidities and mortalities later in life. **Aims and Objectives:** This study was planned to categorize apparently healthy young adults into two groups as obese and non-obese on the basis of BMI to compare levels of glucose and lipid profile among them. BMI >25 is categorized as obese. **Materials and Methods:** A total of 60 male medical students between 17 and 22 years of age from Dr. D. Y. Patil Medical College, Pune, participated in the study voluntarily. Purpose-designed questionnaires were used to ascertain lifestyle behavior and birth weight. They were categorized into obese and non-obese on the basis of BMI. Waist–hip ratio (WHR) was also measured for both the groups. Blood chemistry of these 60 students was studied for glucose and lipid levels. Systolic and diastolic blood pressures were also measured. **Results:** The obese group showed higher levels of total cholesterol (TC), triglycerides (TG), and postprandial blood sugar. No significant difference was seen in the levels of high-density lipoprotein (HDL), low-density lipoprotein, and fasting blood sugar between the two groups. **Conclusions:** Increased levels of TC and TG with no change in HDL levels would be a compounding factor for increasing the risk of atherogenesis. If derangement of these parameters can be detected early in adulthood, it would be useful in identifying the causes for obesity, its treatment, and prevention of complications arising later in life by bringing about a change in lifestyle management.

KEY WORDS: Body Mass Index; Waist-hip Ratio; Lipid Profile, Blood Glucose Level

INTRODUCTION

In a world where food supplies are scarce, the ability to store energy in excess of what is required for future use is essential for survival. Fat cells of the adipose tissue are adapted to store excess energy efficiently as triglycerides (TG) and to release these as free fatty acids when required. This physiological system orchestrated with endocrine, and neural pathways permit humans to survive starvation. This boon has become a double-edged weapon in this era where there is nutritional abundance coupled with a sedentary lifestyle which is influenced by genetic endowment increasing the adipose energy stores and producing adverse health consequences.

Studies have shown that overweight adolescents of either sex between 13 and 15-year-old are an increased risk of becoming

Access this article online	
Website: www.njppp.com	Quick Response code
DOI: 10.5455/njppp.2018.8.1247131122017	

overweight or obese adults presenting with abnormal glucose and lipid profiles.[1]

Epidemiological data suggest that there is an association between central body fat, especially visceral fat and insulin resistance, diabetes, and coronary heart disease (CHD).[2] World Health Organization recognizes obesity as the greatest health threat of 21st century. In India, there is rapidly escalating epidemic of insulin resistance syndrome (diabetes mellitus and CHD). Small size at birth coupled with subsequent obesity increases the risk of IRS in later life. Medically, economically, physiologically and socially, preventing obesity at national or individual level must be preferable to treatment. If the condition that causes obesity can be improved, and if better nutrition and activity levels on a national scale can be facilitated, the health and economic benefits will be profound.

Obesity is a state of the excess adipose tissue mass. Levels of obesity have been escalating rapidly and have reached epidemic proportion in many nations throughout the world in general. While the United States of America and Europe have by far the highest rates of obesity, non-industrialized countries are also experiencing an increase, particularly those countries undergoing economic transition and whose residents are becoming more affluent. India can be grouped under this category. Obesity is strongly linked to cardiovascular disease and Type 2 diabetes mellitus through the promotion of insulin resistance and other associated physiological abnormalities including dyslipidemia, hypertension, and increased left ventricular mass.[3-6] Obesity is the biggest preventable cause of cancer after smoking. Obesity is present in adolescence leads to obesity in adult life.[7-9] There is substantial evidence that obesity in childhood lays the metabolic groundwork for the adult cardiovascular disease.[10]

Body mass index (BMI) and waist–hip ratio (WHR) is a good indicator of obesity. Hence, a simple study was planned to categorize apparently healthy young adults into two groups as obese and non-obese on the basis of BMI to compare levels of glucose and lipid profile among them. BMI >25 is categorized as obese.

MATERIALS AND METHODS

A total of 60 male medical students from Dr. D. Y. Patil Medical College, Pune, of age 17–22 years participated in the study voluntarily. They were categorized into obese and non-obese on the basis of BMI. 30 students with BMI >25 (28.7 ± 6.02) were selected as a study group, and 30 students with BMI <25 (20.7 ± 2.34) were selected as controls. WHR was also measured for both the groups. WHR for obese and non-obese subjects were 0.88 ± 0.05 and 0.80 ± 0.05, respectively. The difference of WHR between groups was statistically significant ($P < 0.0001$). Blood chemistry of these 60 students was studied for glucose and lipid levels. Systolic and diastolic blood pressures (BP) were also measured. Purpose-designed questionnaires were used to ascertain lifestyle behavior and birth weight. Ethics approval for the study was received from "Institutional Ethics Committee."

The biochemical values used were:

a. Fasting and postprandial glucose levels using standard kits by the oxidase-peroxidase method using a bichromatic autoanalyzer.
b. Lipid profile for high-density lipoprotein (HDL) analysis, enzymatic endpoint method was used. ASPEN HDL cholesterol test employs a specific antibody and is applied on an automated analyzer.
c. For total cholesterol (TC) analysis, phenol-free cholesterol reagent was used.
d. For TG analysis, dynamic extended stability with lipid clearing agent was used.
e. Low-density lipoprotein (LDL) was calculated using the formula: LDL (mg %) = TC - HDL - TG/5.

RESULTS

TC in the non-obese group was found to be 142.4 mg/dl (standard deviation [SD] ±4.20). The obese group showed a higher level of TC 154.8 mg/dl (SD ±3.29). The difference in the two groups was found to be statistically significant (as expressed by the p value ($P = 0.0244$). As urbanization occurs, increase in BMI, dietary changes and reduced physical activities result in more overt diabetes and elevation of TC.[11] The TG in the non-obese subjects was found to be 78 mg/ dl (SD ±4.23), and in the obese subjects, it was found to be 117.2 mg/dl (SD ±5.77). The difference in the two groups was found to be statistically significant as expressed as p value ($P < 0.0001$). The HDL level in the non-obese group was 48.5 mg/dl (SD ±0.993) and in obese subjects were 48.00 mg/ dl (SD ±1.213).The difference in the two groups was found to be statistically insignificant as expressed by the p value ($P = 0.8822$). The LDL levels were calculated by the formula: LDL = TC-HDL-TG/5 (mg %). The LDL levels of the non-obese subjects were 78.1 mg/dl (SD ±3.75) and of obese subjects were 84.2 mg/dl (SD ±3.20). The difference in the two groups was not found to be statistically significant as expressed by the p value ($P = 0.2200$). Results are expressed in mean ± SD. The data analysis is carried out using *t*-test and Microsoft Excel 2010. For all the analysis probability values $P < 0.05$ were considered as statistically significant and $P < 0.0001$ was considered as statistically highly significant Ref Table 1.

DISCUSSION

A striking finding of this study was the high prevalence of atherogenic risk factors, notably raised TC and raised TG. In this study, obese subjects had fasting glucose level of 98 mg/ dl, and non-obese had 95 mg/dl. The difference

Table 1: Glucose and lipid profiles of obese and non-obese subjects

Parameters	Obese subjects *n*=30	Non-obese subjects *n*=30	*P*
BMI (kg/m^2)	28.7±6.02	20.7±2.34	<0.0001*
WHR	0.88±0.05	0.80±0.05	0.8822
Fasting blood glucose (mg/dl)	98	95	0.132
Postprandial blood glucose (mg/dl)	110.5	105.5	<0.0001*
TC (mg/dl)	154.8±3.29	142.4±4.20	0.0244
TG (mg/dl)	117.2±5.77	78±4.23	<0.0001*
HDL (mg/dl)	48±1.213	48.5±0.993	0.8822
LDL (mg/dl)	84.2±3.20	78.1±3.75	0.2200
Diastolic BP (mm of Hg)	90	75	<0.0001*
Systolic BP (mm of Hg)	128	110	<0.0001*

*P<0.0001 statistically highly significant. TC: Total cholesterol, TG: Triglycerides, HDL: High-density lipoprotein, LDL: Low-density lipoprotein, BMI: Body mass index, WHR: Waist–hip ratio, BP: Blood pressure

in the two group as expressed by the p value (P = 0.132) was not found to be statistically significant. Postprandial glucose levels among non-obese subjects were 105.5 mg/dl whereas obese subjects showed higher postprandial glucose level of 115.5 mg/dl. The difference in the two groups as expressed by the p value (P < 0.0001) was found to be statistically significant. This study also evaluated the systolic and diastolic BP of both obese and non-obese subjects. Obese subjects had systolic BP of 128 mm of Hg and non-obese had systolic BP of 110 mm of Hg. The findings were statistically significant as expressed by p value (P < 0.0001) were found to be statistically significant. This may be due to the central and peripheral abnormalities that can explain the development of high arterial pressure in obesity which include activation of the sympathetic nervous system and Renin-angiotensin-aldosterone system.[12]

In support of the present findings of notably raised TC and TG, a study performed among medical students in South Africa showed 16.9% students having raised TC levels.[3] Similarly, a study conducted among medical students at Louisiana State University, USA reported the prevalence of high TC among 18% of men. Another study among medical students of University of California showed 20% have hypercholesterolemia.[3] This study fortifies the fact that Indians are at a higher risk of metabolic complication leading to CHD even at a lower BMI. This study did not find any significant change in the values of HDL and LDL levels among obese subjects as compared to the non-obese subjects. Similar observations of near-normal LDL levels in obese subjects were cited in other studies.[4] A study was done on Bengali population, who consume a lot of fish which contains Omega 3 Polyunsaturated Fatty Acids, also got similar findings with normal HDL levels.[4] This is at variance with the lipid profile seen in adult Indians. This study also evaluated the fasting and postprandial blood glucose levels. The relationship between hyperglycemia assessed by glycosylated hemoglobin and microvascular complications has been clearly established in Type 2 diabetes, and good glycemic control has been shown to prevent these complications. However, the precise link between glycemic and microvascular complications remains unclear. A meta-analysis including 95,783 subjects followed on average for 12.4 years demonstrated an exponential relationship between the incidence of cardiovascular events and 2 h postprandial plasma glucose. Several other studies including Hoorn study, Honolulu heart study, and the Chicago heart study have shown that the glucose level 2 h after an oral glucose challenge is a powerful predictor of cardiovascular risk.[13-15]

No large-scale interventional studies with the primary objective of reducing cardiovascular complications by targeting postprandial glucose values have been conducted. However, numerous epidemiological and observational studies have demonstrated an association between postprandial hyperglycemia and cardiovascular mortality. Several experimental studies have also demonstrated the potential proatherogenic role of postprandial glucose levels.[16] The significant rise in the postprandial glucose level of obese subjects may be due to the presence of insulin resistance in these subjects. However, this study did not evaluate the level of fasting insulin or indices for insulin resistance such as Homeostatic model assessment or similar models. Similarly, a glucose tolerance test was also not performed to find out the measure of insulin resistance, thus this may require further evaluation.

Assessing the risk for the presence of major CHD risk factors in young adults is of particular importance. Increased levels of TC, TG with no change in HDL levels would be a compounding factor for increasing the risk of atherogenesis.[15] Thus, intervention in this age group would be of particular significance to prevent obesity-associated comorbidities and mortalities. In this context obesity index such as BMI and WHR is considered as a useful non-invasive anthropometric measurement to provide information on cardiovascular risks. Further studies involving a much larger sample size and additional investigations could provide useful guidance to assess the risk of obesity-associated diseases in young Indian students. This would provide us with definite answers to these risks in this population and also help to plan suitable strategies to overcome this burden. This study is the only representative of the medical student population. Suitable studies could also be extended to other population strata to investigate the presence of obesity and associated risk factors.

CONCLUSION

Increased levels of TC, TG with no change in HDL levels would be a compounding factor for increasing the risk of atherogenesis. These can be detected early in adulthood it can be useful in the detection of causes for obesity, its treatment, and prevention of complications arising later in life. Help in bringing about a change in lifestyle management for leading a healthy lifestyle. The greatest challenge of public health is to develop effective preventive measures, recognizing that BMI >25 before the age of 20 years is a very strong predictor of obesity and ill health in adulthood.

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How to cite this article: Pisharody IK, Prasad NB. Body mass index an early indicator of abnormal glucose and lipid profiles in young Indian adults. Natl J Physiol Pharm Pharmacol 2018;8(5):690-693.

Source of Support: Nil, **Conflict of Interest:** None declared.