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COMPARATIVE STUDY OF GLYCATED HEMOGLOBIN AND LIPID PROFILE AMONG HEALTHY OBESE AND NON-OBESE YOUNG INDIVIDUALS FROM WESTERN INDIA

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ABSTRACT

Introduction

The menace of obesity is attaining an epidemic worldwide with immense health and economic implications. It is a complex multifaceted disorder associated with serious non-communicable diseases like diabetes mellitus and cardiovascular disorders. This study was designed to analyze the association of obesity with glycated hemoglobin (HbA1c) and lipid profile components.

Materials and Methods

This study included 60 obese and 60 non-obese apparently healthy young adults. The anthropometric characteristics, HbA1c and lipid profile variables - Total Cholesterol (TC), Triglycerides (TG), Low Density Lipoprotein (LDL) and High Density Lipoprotein (HDL) were assessed in all the study participants.

Result

The mean values of HbA1c, TC, TG and LDL were significantly increased while HDL was decreased in obese than non-obese group. Body mass index showed significant positive correlation with HbA1c, TC and LDL and negative correlation with HDL.

Conclusion

We found that although young, obese individuals are at high risk of developing cardio-metabolic complications in near future. Preventive strategies like therapeutic life style modifications should be robustly encouraged to curb the burden of these disorders, thereby improving lifespan and quality of life. This will redefine the paradigms of obesity care in India.

KEYWORDS : Obesity, Glycated Hemoglobin, Dyslipidemia, Cardio-metabolic Disorders.

INTRODUCTION

The universal burden of obesity is rising at an alarming rate. Its prevalence has increased in pandemic dimensions over the past ~50 years, affecting virtually all ages and socioeconomic strata. Globally, in 2015, around 1.9 billion and 609 million adults were overweight and obese respectively, depicting nearly 39% of the world's population.[1] Obesity an intricate, multifaceted disorder has been well acknowledged as a disease in its own entity with all-embracing medical, social and economic consequences. It constitutes a substantial risk to serious non-communicable diseases in particular diabetes mellitus, cardiovascular diseases, hypertension, certain cancers and poor mental well-being.[1] All of these have unfavorable impact on the quality of life, work productivity and healthcare outlay.[2] India, notorious for undernourishment, is now a terrain of obesity. At the other edge of malnutrition scale, it is one of today's blatantly evident – so far most overlooked – public health problems. If prompt action is not taken, millions will suffer from an array of serious health disorders.

Obesity is one of the crucial risk factors for type 2 diabetes mellitus (T2DM) preceded by impaired glucose tolerance. The risk of diabetes is increased seven times in obesity and threefold in overweight as compared to normal weight people.[7] Obesity due to excess adipose tissue mass sets off the various biochemical changes leading to decreased insulin sensitivity. In obese person insulin resistance develops at an early age which afterwards progresses to full blown diabetes.[7] Worldwide, about 175 million individuals remain undiagnosed with diabetes. The disease process sets in much before its clinical appearance. Accordingly, the age of diagnosis might not accurately reflect the age of onset of the disease.[4] Glycated hemoglobin (HbA1c) is the gold standard test extensively employed for the screening and diagnosis of diabetes mellitus.[6] This accurate and precise test reflects the glycemic status through the past 3 months.[2] In obesity with increased propensity for glucose metabolism abnormalities, HbA1c might have an excellent proficiency and increased clinical applicability than in normal weight persons.[6]

Cardiovascular diseases (CVD), the epidemic of modern civilization, is the eminent cause of morbidity and mortality in the world. It accounts for 31.7% of total deaths in India, where it exhibits itself almost 10 years beforehand than rest of the world.[3] Dyslipidemia substantially contributes to the pathogenesis of CVD. It is linked with more than half cases of ischemic heart disease and around 4 million deaths per annum and has been recognized as the best risk predictor for cardiovascular complications.[4] Obesity is the predecessor of CVD which is relatively mediated by virtue of dyslipidemia.[5] Unusual visceral fat depot in obesity aberrantly affects lipid metabolism that leads to atherogenic dyslipidemia.

HbA1c is a validated independent risk component of CVD. Raised HbA1c in obesity might intensify the risks of deleterious cardiovascular outcomes as well and all-cause mortality. Thereupon, HbA1c can be employed as a biomarker for both cardiovascular and diabetic risk in obesity. Earlier recognition of diabetic and CVD risk patients will be fruitful to curtail the invariably increasing incidence of these comorbidities, by implementing the appropriate lifestyle modifications. With this presumption, this study was designed to ascertain the association of obesity with HbA1c and lipid profile panel for the early identification of high risk individuals. Moreover, the novelty of our research was for the healthy young adult population owing to paucity of analogous studies.

MATERIALS & METHODS

Institutional Ethical Committee for Clinical Research approved the study protocol. This study constituted of 60 non-obese, seemingly healthy subjects as controls and 60 obese subjects as cases as denoted by body mass index categories (BMI < 25 and BMI ≥ 30 kg/m^2 respectively) between 20 to 30 years age. Pregnant & Lactating women, persons with hypertension, diabetes, cardiovascular or renal diseases and metabolic disorders affecting lipid profile were excluded from the study. Besides, those taking lipid lowering drugs, antihypertensive or antidiabetic medication and oral contraceptive pills were ruled out. Written informed consent was obtained from all the participants prior to recruitment in the study. Anthropometric parameters along with biochemical data were obtained.

Anthropometric Indices:

Weight and height were measured up with participants wearing light clothing and without shoes. Weight (kg) was measured using a digital scale. Height (m) was measured using a wall-mounted ruler, with the subject standing with feet together and with head, shoulder, buttocks and heels touching the wall. Waist circumference (WC) (cm) was measured midway between the lower border of the rib cage and iliac crest at the end of expiration. Hip circumference (HC) (cm) was measured at the level of greater trochanter with no compression. BMI was calculated as weight (kg) divided by height

squared (m^2).

Analytical Methods:
Venous blood samples were obtained after 12 hour of fasting for biochemical evaluation. Blood glucose and lipid profile variables including total cholesterol (TC), triglycerides (TG) and high density lipoprotein (HDL) were assessed on fully-automated-analyzer system (XL-640, Transasia) using commercial ERBA kits. Low density lipoprotein (LDL) was calculated by the Friedewald formula: [LDL = TC - HDL - (TG/5)]. HbA1c was analyzed by Ion Exchange Resin Method using commercial kits from ERBA diagnostics.

STATISTICAL ANALYSIS:
The results were assayed by employing SPSS (Statistical Package for Social Sciences) software. The data were expressed as mean ± standard deviation (SD). Differences in biochemical parameters were statistically assessed by applying Student's t-test. Pearson's correlation coefficient test was used to study the correlation among variables (r value). *P* value < 0.05 was accounted as statistically significant.

RESULT
An illustration of demographic attributes of the study and the control group is presented in

Table 1. Mean values of BMI and W/H ratio were significantly raised in obese group than in non-obese group.

Table 2 demonstrates the laboratory data inclusive of HbA1c, lipid profile and blood glucose in obese and non-obese categories. It revealed that mean values of HbA1c, TC, TG and LDL were significantly higher whereas HDL was decreased in obese subjects as compared to the controls (P < 0.05).

Table 3 displays the correlation analysis between BMI and HbA1c in obese group. A significant positive correlation was found between these two variables.

Table 4 shows the correlation of BMI with lipid profile components in obese class. BMI correlated positively with TC and LDL and negatively with HDL which is statistically significant.

Table 1. Comparison of Demographic Characteristics in Obese and Non-obese Groups:-

Sr. No.	Demographic Characters	Obese Cases (60)	Non-Obese Controls (60)	'P' value
1.	Age (years)	25.98 ± 4.63	24.71 ± 3.59	-
2.	BMI (kg/m^2)	34.81 ± 4.95	23.45 ± 2.79	**< 0.05***
3.	W/H ratio	0.93 ± 0.06	0.81 ± 0.05	**< 0.05***

Table 2. Comparison of Biochemical Parameters in Obese and Non-obese Groups:-

Sr. No.	Biochemical Parameters	Obese Cases (60)	Non-Obese Controls (60)	'P' Value
1.	HbA1c (%)	6.86 ± 1.07	5.27 ± 0.31	**< 0.05***
2.	Blood Glucose (mg %)	109.65 ± 22.75	89.82 ± 7.34	-
3.	TC (upto 200 mg %)	207.08 ± 31.0	175.24 ± 7.9	**< 0.05***
4.	TG (upto 150 mg %)	155.14 ± 25.4	119.47± 10.1	**< 0.05***
5.	HDL (40 – 60 mg %)	40.31 ± 6.9	51.48 ± 3.9	**< 0.05***
6.	LDL (upto 100 mg %)	135.75 ± 28.3	99.87 ± 9.7	**< 0.05***

Table 3. Correlation of BMI with HbA1c in Obese Group:-

Group	Biochemical Parameters ('r' value)		'P' value
		BMI	
Obese	HbA1c	0.53	**< 0.05***

Table 4. Correlation of BMI with Lipid Profile in Obese Group:-

Group	Correlation Coefficient Analysis				
	Variables	TC	LDL	HDL	'P' value
Obese	BMI	0.48	0.43	− 0.51	**< 0.05***

DISCUSSION
Obesity is coming up as to one of the serious public health challenges of 21st century that jeopardizes the health, well-being and economic prosperity of virtually each and every province globally.[2] Paradoxically coexistent with undernourishment, an escalating global obesity pandemic – "globesity" – is expanding all over the world with a decline in longevity and quality of life.[1] It has been acknowledged amongst the top 10 global risk factors contributing to ~40 % mortality by WHO.[4] This study was undertaken to assess the HbA1c along with lipid profile in obese and non-obese young adults, with regard to study the after-effects of obesity on these biochemical variables.

In our study, it was revealed that Hb1Ac was significantly raised in obese group than controls. This finding is supported by the studies of AC Elochukwu et al[2], AU Emeribe et al[14] and LI Graur et al[15]who noted parallel conclusions. In obese group, BMI showed a significant positive correlation with HbA1c. This is in accordance with further researchers who described that with increasing BMI there was rise in HbA1c values.[2,14,15]

Excessive deposits of adipose tissue in obesity bring on insulin resistance with ensuing hyperinsulinemia to maintain blood glucose levels. Beyond a certain point, recompensing pancreatic ß-cells fail down, inducing hyperglycemia.[16] Obesity is accompanied by impaired glucose tolerance, variations of insulin-glucose homeostasis, reduced metabolic clearance of insulin and diminished insulin-stimulated glucose utilization.[14] Moreover, obesity appears to take effect even as a strong autonomous predictor of systemic oxidative stress & pro-inflammatory state resulting in enhanced hemoglobin glycation regardless of glucose levels.[17] This justifies raised HbA1c in obese subjects besides its correlation with BMI.

In current study we observed that serum TC, TG and LDL were significantly elevated whereas HDL was reduced in obese subjects in comparison with non-obese subjects. This is in conformance with the studies conducted by AC Elochukwu et al[2], AG Aljaffar et al[8], Riddhi Patel et al[5] and MN Khan et al.[9] In their research project, lipid profile variables were deranged in obese class as compared to controls. Nevertheless, M Manjareeka et al[10], GS Begum et al[11] did not found any significant variation between two groups for lipid profile parameters.

We noticed that BMI displayed significant positive correlation with TC, LDL and negative correlation with HDL in obese group. AC Elochukwu et al[2], Satendri Devi et al[3], Mitra Zarrati et al[12] and KM Turki et al[13] found resemblant outcomes in their study report. On the other hand a-few researchers recorded no significant correlation between BMI and any of the lipid profile variables.[5,11]

Excess amount of adipose tissue in obesity is linked to the progression of insulin resistance. Subsequent hyperinsulinemia results in the unusual changes in lipid and lipoprotein metabolism. Enhanced release of non-esterified fatty acids from the visceral fat depots bring on increased biosynthesis of TG-rich lipoproteins in the liver. TG-rich HDL particles are catabolized much more rapidly causing HDL level to decline.[13] This may elucidate the atherogenic dyslipidemia in obesity which ultimately contributes to the increased cardiovascular risk.

Obesity, the forerunner of diabetes and cardiovascular diseases is regarded being a modifiable risk factor for aforesaid disorders.[15] Literature studies have proved that elevated HbA1c is associated with atherogenic dyslipidemia and vice versa as the correlation between these parameters proceeds hand-in-hand increasing the cardio-metabolic risk.[4] Therefore, further analysis on the prediction of these life threatening outcomes in obesity must be sought. The estimation of HbA1c in obesity could help to identify high risk participants, with the predictability being improved by inclusion of lipid profile.[2]

In present study, even though the obese participants were young, raised HbA1c and deranged lipid profile was noted which is oblivious to them. They may potentially suffer from cardiac and metabolic complications afterwards in their lifetime. Accordingly, assessing HbA1c and lipid profile amongst obese people will aid in the identification of individuals at diabetic and cardiovascular risk. Placing people sooner in high risk categories denotes much earlier inception of treatment thereby improving life expectancy and quality

of life with minimal costs. Small sample size and enrollment of participants from one single center are the limitations of this study.

CONCLUSION

In our study, raised HbA1c and atherogenic dyslipidemia was noticed in apparently healthy, young obese individuals. BMI showed positive correlation with HbA1c, TC and LDL and negative correlation with HDL. The aforementioned findings are associated with untoward healthcare outcome in terms of type 2 diabetes mellitus and cardiovascular diseases. Though young, obese participants are at high risk of these complications latterly in their lifespan and they are unaware of that. They should be counseled regarding possible health hazards and motivated to adopt preventive measures. A public health approach with effective implementation of comprehensive health care strategies is required. These include lifestyle interventions, behavioral modification, psychological counselling and pharmacological therapies. This will help to curb the burden of obesity and related complications and to redefine the paradigms of obesity care in India.

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