RELATIONSHIP BETWEEN OBESITY AND SERUM CALCIUM LEVEL IN POPULATION OF CENTRAL INDIA: A CROSS-SECTIONAL STUDY

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Abstract

Introduction: Characterized by excess adipose tissue mass and body fat distribution may have a negative impact on health of a people and their wellbeing. . Prevalence of obesity has drastically increased in last three decades which has been found to reduce the life expectancy and overall quality of life. One among six adults all over the world and nearly 2.8 million individuals die every year due to obesity or being overweight according to the WHO. There is a huge burden of cost associated with obesity in health care system due to long term consequences of the disease. Calcium stimulates the activity and expression of fatty acid synthase which is a key enzyme in *de novo* lipogenesis and inhibits lipolysis in calcium dependent trend. Various important functions such as neuronal activity, muscle contraction, aggregation of platelets, and resistance of insulin, cellular death and hypertension are mediated by intracellular calcium. Thus increase in concentration of intracellular calcium adipose tissues promotes storage of triglycerides in adipocytes by exerting a control of lipogenesis and lipolysis in coordination.

Material & Methods: This cross-sectional study was conducted at K.M. Medical College and Hospital Matura UP. The study was done on 100 subjects with same number of healthy matched controls. Those patients with pre-existing disease such as cardiovascular disease, diabetes mellitus, hypertension, endocrine disorders, renal diseases, smoking, subjects on oral vitamin D or calcium supplementation or family history of obesity or postmenopausal women, pregnant females were excluded from the study.

Results: It is observed that the serum calcium levels were significantly high in cases i.e. obese subjects compared to non-obese controls. Correlation of serum calcium with BMI was 0.65 while with waist to hip ratio it was found to be 0.51 among cases. In controls the correlation of BMI and serum calcium was observed to be 0.32 whereas it was 0.21 with waist to hip ratio.

Conclusion: From present study it can be noted that serum calcium is positively correlated with BMI and waist to Hip ratio and are increased in obese people. This supports the assertion that calcium may have a fundamental role in risk of development of obesity and obesity may have an impact on calcium metabolism which leads to hypercalcemia.

Introduction

Characterized by excess adipose tissue mass and body fat distribution may have a negative impact on health of a people and their wellbeing. The imbalance between amount of calorie consumption and energy expenditure is the primary cause of obesity¹. Urbanization and modernization along with behavioral, social, environmental and genetic factors, and decrease in physical activities leads to obesity². As a result of hypertrophy and hyperplasia of adiposities, an individual can accumulate 70% of body mass fat. Most common method of measuring obesity is referred as Body Mass Index (BMI) which estimates human body fat based on height and weight of an individual³. Prevalence of obesity has drastically increased in last three decades which has been found to reduce the life expectancy and overall quality of life⁴. Obesity is one of the most leading as well as

neglected preventable cause of death which is rapidly increasing all over the globe⁵. In both developed as well as developing nations obesity is associated with serious psycho-social dimensions virtually affecting people of all ages and socioeconomic status. Due to likelihood of many other non-communicable diseases like type 2 diabetes mellitus (58%), cardiovascular disease(21%), several types of cancer (8% to 42%), depression, hypertension, osteoarthritis and asthma². In 1997 the World Health Organization (WHO) formally recognized obesity a global pandemic³. One among six adults all over the world and nearly 2.8 million individuals die every year due to obesity or being overweight according to the WHO. India is the second most populous country in the world which comprises of 17% of total population in the world and 16% of deaths around the globe has faced under nutrition for decades due to poverty and is now being exposed to the over nutrition of modern world through globalization and

affluence⁶. There is a huge burden of cost associated with obesity in health care system due to long term consequences of the disease. Obesity is referred as “New World Syndrome” which means that the disease can be viewed as first wave of defined cluster of non-communicable diseases creating an enormous health and socio-economic burden all around the globe. A macro-mineral known as Calcium (Ca^{2+}) is believed to play a key role in intracellular as well as extracellular compartments. Extracellular calcium is important for mineralization of bones, coagulation of blood, etc. whereas intracellular calcium has various critical roles to play. In a diverse biological process calcium plays the most versatile, ubiquitous second messenger in several pathways in coordinating key events of biological process. Calcium is also thought to play a very important role in modulating the factors involved with regulating overweight of an individual⁷. Calcium stimulates the activity and expression of fatty acid synthase which is a key enzyme in novo lipogenesis and inhibits lipolysis in calcium dependent trend⁸. Various important functions such as neuronal activity, muscle contraction, aggregation of platelets, and resistance of insulin, cellular death and hypertension are mediated by intracellular calcium. Thus increase in concentration of intracellular calcium adipose tissues promotes storage of triglycerides in adipocytes by exerting a control of lipogenesis and lipolysis in coordination⁹. Not much is known about the association of obesity and serum calcium levels. Hence this study was conducted to evaluate concentrations of serum calcium in obesity.

Material & Methods:

This cross-sectional study was conducted at K.M. Medical College and Hospital Matura UP. The study was done on 100 subjects with same number of healthy matched controls. Informed consent was taken from subjects included in the study. Demographic characteristics, anthropometric reading and biochemical data were obtained from the subjects under study investigation.

Inclusion criteria: Subjects aged 30 years to 60 years both male and female were included in the study.

Exclusion criteria: Those patients with pre-existing disease such as cardiovascular disease, diabetes mellitus, hypertension, endocrine disorders, renal diseases, smoking, subjects on oral vitamin D or calcium supplementation or family history of obesity or postmenopausal women, pregnant females were excluded from the study. Weight (in kgs) and height (in cms) was measured by an electronic scale with subjects barefoot and each subject standing erect against wall without shoes with a wall mounted ruler respectively. Waist circumference was measured at a point midway between the upper border of iliac crest and the lowest rib margin at the end of normal expiratory phase using a non-

stretchable tape. Hip circumference (in centimeters) was measured by a tape at the widest point over the buttocks with no compression¹⁰. Body Mass Index (BMI) was calculated as $\text{weight(kg)}/\text{height(m}^2\text{)}$ along with wait to hip ratio. Participants in study were categorized into two groups as controls(non-obese) and cases(obese). The classification was done to BMI category as $\text{BMI} < 25\text{kg/ m}^2$ and $\text{BMI} \geq 30\text{kg/ m}^2$ according the criteria provide by WHO¹¹. Venous blood samples were collected from all the participants and analyzed for serum calcium on fully-automated-analyzer. Serum calcium was estimated by the O- Cresolphthalein Complexone (OCPC) method. Statistical analysis was done using IBM SPSS version 20. Data were expressed as mean $\pm$ standard deviation(SD). Pearson's correlation coefficient was calculated to study if there was any correlation between the parameters. Student's t test was used to study differences between quantitative demographic and biochemical characteristics.

Results:

Table 1: Demographic characteristics in cases(obese group) and controls(non-obese group)

Variable	Cases (n = 100)	Controls (n = 100)	p – value
Age(in years)	36.92 $\pm$ 11.02	35.68 $\pm$ 13.05	>0.05
BMI(kg/m ²)	34.43 $\pm$ 5.05	24.11 $\pm$ 3.51	<0.05
Waist to HIP ratio	0.91 $\pm$ 0.06	0.77 $\pm$ 0.03	<0.05
Sex (M/F)	56/44	60/40	-

It is observed that the BMI and Wait to Hip ratio differed significantly among cases and controls in this study.

Table 2: Comparison of serum calcium among cases and controls

	Cases (n = 100)	Controls (n = 100)	p – value
Serum Calcium (mg%)	12.81 $\pm$ 0.93	9.87 $\pm$ 0.61	<0.05

It is observed that the serum calcium levels were significantly high in cases i.e. obese subjects compared to non-obese controls.

Table 3: Hypercalcemia incidence among cases and controls

	Cases (n = 100)	Controls (n = 100)
Normocalcemia	16(16%)	81(81%)
Hypercalcemia	84(84%)	19(19%)

No. of cases with hyperglycemia were higher in cases compared to controls.

Table 4: Correlation of Serum Ca with MBI and waist to hip ratio

	Cases	Controls
BMI	0.65	0.32
Waist to Hip	0.51	0.21

Correlation of serum calcium with BMI was 0.65 while with waist to hip ratio it was found to be 0.51 among cases. In controls the correlation of BMI and serum calcium was observed to be 0.32 whereas it was 0.21 with waist to hip ratio.

Discussion:

Rooted in sedentary nature of modern lifestyle, obesity is a systemic, complex and multi-causal problem. The prevalence of obesity is on alarmingly rise among adolescent and children which a cause to worry given heavy burden of complications associated with disease. Obesity is most blatantly visible yet neglected health problem at other end of malnutrition. Co-existence of obesity with under nutrition is taking over many parts of the world. In present study it is observed that the total serum calcium levels were higher in cases (obese subjects) compared to controls (non-obese subjects). Also a significant positive correlation has been noted in serum calcium level with BMI and waist to hip ratio among cases. The findings in present study are in agreement with various other studies. Akter N et al², Shah P et al⁵, Xiao-hua Ren et al⁷, and Omid Dalfardi¹⁰ reported similar findings as in present study. A similar positive correlation was reported in these studies of BMI and serum calcium levels. Emellpek et al¹², Mohammad et al¹¹ reported that there was no significant difference in calcium levels among obese and non-obese study participants. The association of serum calcium with obesity is complicated and much is need to explain. Some probable explanations for the process involved with this association may be that the obese individuals tend to have high parathyroid hormone level and low basal vitamin D in comparison to non-obese individuals¹. In turn this elevates the calcium influx into variety of cells including adipose tissues. Cellular activity increases intracellular calcium activity of fatty acid synthase which exhibits the hormone-sensitive lipase resulting in promotion of lipogenesis and inhibition of lipolysis¹³. It also stimulates 3B phosphodiesterase, which in turn decreases lipolysis caused by catecholamine. These effects will eventually facilitate stocking of lipids in fat tissue. Obesity is known to be a chronic low-grade, systemic inflammatory disease associated with elevated oxidative stress. This results in increased development of pro-inflammatory cytokines, which promotes increased osteoclastic activity and bone resorption¹⁰.

Conclusion:

From present study it can be noted that serum calcium is positively correlated with BMI and waist to Hip ratio and are increased in obese people. Hence obesity may have an impact on metabolism of calcium and increased calcium levels. This supports the assertion that calcium may have a fundamental role in risk of development of obesity and obesity may have an impact on calcium metabolism which leads to hypercalcemia.

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