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Original Article

Retrospective Study of Biochemical Markers and Risk Factors in Obese and Non-Obese Adolescence

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Abstract: Obesity is a chronic disease defined by an excessive accumulation of body fat that represents health risks, being considered now a days the major public health problem worldwide. Obesity is characterized as a low-grade inflammatory disease due to the variety of pro-inflammatory adipokines secreted by adipose tissue, especially visceral adipose tissue. This inflammation is characterized by macrophage infiltration and expression of inflammatory adipokines, which are related to insulin resistance, blood pressure, and vascular endothelium alterations. These alterations are closely related to development and progression of diabetes and cardiovascular disease, including paediatric patients. Obesity considered now as one among the major global issue affecting young adults. Rapid changes in sedentary lifestyle choices were the risk factors for obesity including unhealthy diet patterns, expending time in front of TV and lacking physical activity etc. The present study aimed for correlating the risk factors of obesity with healthy groups among the adolescent population. And the result was recorded with significant level of elevation in most of the parameters in cases than control and the significance was represented as student's test ($p<0.001$).

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INTRODUCTION

The clinical term Obesity refers to accumulation of fat in the human body beyond the required amount for the normal body function. Its prevalence continues to increase worldwide. Continuous accumulation of body fat results in weight gain. When the prevalence of obesity increases the burden of its associated co-morbidities also gets increased. Non-communicable diseases and their risk factors including obesity are now becoming a significant problem not only in affluent societies but also in developing countries. (Flegal *et al*., 2002; Lopez *et al*., 2006; Baingana and Bos, 2006; Gungor, 2014).

According to World Health Organization (WHO) overweight and obesity considered as abnormal or excessive fat accumulation that would be risk for health (WHO, 2016a). A body mass index (BMI) 25 kg/m2 was generally considered overweight, while obesity was considered to be a BMI 30 kg/m2. It was very familiar that obesity and overweight were the growing global problem with high rates in both developed and developing countries (Capodaglio and Liuzzi, 2013).

Generally the body fat was classified into two types, the essential and the storage fat. The essential fat always necessary for the normal functions of the body and was mainly stored in the bone marrow, heart, lung, liver, spleen and muscle. Fat stored in the breast and hips of women also included in essential fat whereas the fat stored mainly in the subcutaneous tissue obtained due to additional energy received through food were the Storage fat. In healthy young adults the total body fat represents the 15-20% of total body weight for men and 20-25% of total body weight for women (Sturn, 2002).

Based on distribution the fat may classified as Central (Android type) and Regional (or female type). The fat present at the upper torso and abdomen of male was the Central type and similarly the fat deposited at thighs and hips of female is the Regional type which characterizes women.The severity of obesity is estimated from the total amount of fat and the fat distribution in the human body (Sunyer,2004: Manolopoulos *et al*., 2010).

Obesity being a chronic disease characterized as a low-grade inflammatory disease due to the variety of pro-inflammatory adipokines secreted by adipose tissue, especially viscera adipose tissue. This inflammation is characterized by macrophage infiltration and expression of inflammatory adipokines, which are related to insulin resistance,

blood pressure, and vascular endothelium alterations. These alterations are closely related to development and progression of diabetes and cardiovascular disease, including paediatric patients (DeBoer, 2013). Obesity now turned over as global pandemic and was also a matter of public health burden spreading to all the age groups, including children and adolescents. In recent years obesity occurred as global epidemic prevails among adolescents, and the prevalence is continuing to rise in this population(Reilly, 2006). A recent study conducted in India reported that the Age- standardized prevalence of overweight was 17.8% among boys and 15.8% among girls. The adolescence people start to make individual choices and develop a personalized lifestyle during their teenage where many of these chosen lifestyle were related to risk factors for obesity, such as unhealthy diet patterns, increased TV watching, prolonged working with computers and laptops and above all lack of physical activity, all of which were largely modifiable (Ramachandran *et al*., 2002) .

Rapid increasing rates of overweight and obesity has reached epidemic proportions among developed countries, middle-income and less-developed countries. The proportion of children in the general population who were overweight and obese has doubled over the past two decades in developed and developing countries including India (Bundred, 2001).

Obesity is one of the main medical and financial burdens for the State governments. By creating public awareness about obesity and its health consequences the problem can be easily preventable. The present study is aimed for screening of clinical markers of obesity and the associated risk factors among the adolescence groups in the study area.

MATERIALS AND METHODS

Participants and study design

The current study was a descriptive and case control study in its design examined 60 samples of adolescences for a period of 3 months duration (from November 2018 to January 2019) which includes obese (n=30) and non-obese (n=30) participates from Korkadu area, Puducherry, South India. The family history was collected from all the participates by oral or questionnaire method. Venous blood (5mL) was collected by venipuncture method from all the participates and serum was analysed for Estimation of Blood Glucose(GOD-POD), Urea(Berthelot Method), Creatinine (Modified Jaffe's Method), Lipid profile(CHOD-POD Method), LFT (GRAFS Method), undertaken by Spectrophotometric assay along with Hb .

Body mass index (BMI) was assessed as self-reported weight (kg) divided by the square of self-reported height (in meters), and classified in accordance with the international classification system of the World Health Organization (WHO,2019): Underweight (<18.5 kg/m2); normal weight (18.5–24.9 kg/m2); overweight (25.0–29.9 kg/m2); obese (30–39.9 kg/m2); and severe obese c ($\leq$40 kg/ m2).

Statistical analysis

Data was recorded on a predesigned proforma and managed on an Excel spreadsheet. Frequency and percentage of each parameter was calculated and analyzed. The risk estimates were analyzed between the cases and controls expressed in the form of Mean ± SD with *p* values. The student t-test was used to assess the statistical differences between cases and control and *p* value of <0.001 was considered significant.

RESULT AND DISCUSSION

The prevalence of overweight and obesity among people was increasing rapidly in both developed and developing countries and it was a major global public health concern (Sundquist and Johansson, 1998). Enlightening the fact the current case control study examined 60 samples of obese and non obese adolescence participates and the study was conducted at Biochemistry Dept, Divine Mother College, Korkadu, Puducherry, South India. The result of all the biochemical markers between case and control were represented. (Table.1 & Fig.1).

In the present investigation the BMI was found significantly increased (p<0.001) in cases (27.1±4.75) than controls (22.13±4.01) and no statistical significance (p=0.10) were observed with age for both case(18.9 ±2.3) and control (18.06±1.5). 1.7 billion people are exposed to health risks factors related to body weight while the increase in Body Mass Index (BMI) would be sole responsible for more than 2.5 million deaths annually which is expected to be double by 2030 (Blomster *et al.*,2014). Recent report stated that skipping of breakfast was associated with BMI strongly compared to other factors. Missing breakfast increased the consumption of snacks and fast foods (Ghosh, 2007).

Indoor activity like watching TV, playing video games was seen in significant percentage of obese categories. An earlier report stated that eating in front of TV might be a significant risk factor for obesity. High degree of sedentary life style habits were practiced in obese children might be the factor for obesity (Patil and Srinivas, 2018). In case of an obese mother; offspring's obesity onset occurs earlier regardless of race or ethnic groups. And the combination of having an obese mother and an earlier onset of obesity affects young adulthood causing higher BMI and weight (Larsen *et al.*, 2007).

Obesity at present is a leading risk factors for many chronic diseases including insulin-resistance, Type 2DM, gastroesophageal reflux, hypertension, dyslipidemia, cardiovascular diseases and certain types of cancers (Cefalu *et al*.,2015). Obesity developed due to modern lifestyle habits such as excessive food intake , reduced physical activity, environmental factors, psychological effects and genetic susceptibility, which all influences on general health and mortality (Chan and Woo,2010). Obesity in children also increases the risk of insulin-resistance, disturbed lipid metabolism and hypertension (Gungor, 2014).Moreover, obesity hastens the ageing process, reduces the quality of life and increases morbidity and mortality even at an early age in life (Chapman, 2010).

In the present study hip waist was found significantly higher (P<0.001) in obese (45.3±5.45) than non- obese (32.13±4.80) controls. A waist circumference of >94cm in men and >80cm in women, indicates an increased risk of diseases such as coronary heart disease CHD). This measurement is widely used in the classification of obesity. Body composition will be changing in every stage of life and will be reflected in measurement. The WHR has been used as an indicator or measure of health, and the risk of developing serious health conditions. WHR correlates with fertility (with different optimal values for males and females). WHR is used as a measurement of obesity, which in turn is a possible indicator of other more serious health conditions. The WHO states that abdominal obesity is defined as a waist–hip ratio above 0.90 for males and above 0.85 for females, or a body mass index (BMI) above 30.0 (Ying et al., 2010).

Waist circumference is a tool for assessing abdominal fat and health status. In postmenopausal women estrogens deficiency plays an important role in the change of body composition and fat tissue distribution (Li *et al*., 2014).

Waist circumference, waist–hip ratio and waist–height ratio, have been suggested as being superior to BMI in predicting CVD risk (Lee *et al.,* 2008).

Hb levels (p<0.01) for cases (11.25±1.37) were elevated than the controls (14.42±0.72) and there was no abnormalities detected in blood pressure in both cases and controls. The link between BMI and anemia was well documented where many researchers described the association between anemia, overweight and obesity (Zimmermann *et al.*, 2008).

Obesity is more prevalent in females than males. In developing countries like India, females are more obese than males mostly due to the sedentary lifestyle and lack of exercise and in particular physical activity is restricted due to the use of motor vehicles for transport, use of lifts for going to upstairs, etc (Gouda and Prusty, 2014).

Due to rapid growth and biological rhythms, there is an increase iron requirement in both boys and girls during adolescent period. In girls, the iron deficiency is more seen due to menstrual bleeding. Nutritional anemia is seen throughout the world but is more seen in the developing countries and among low socioeconomic group. However, iron deficiency anemia is also seen in young girls of urban population due to poor food habit and reduced physical activity (Kaur *et al*., 2015).

The deficiency of iron in among the obese individuals may be due to low intake of iron(due to unbalanced diet), low absorption of iron in small intestine and finally increased iron requirements caused by a larger blood volume. In addition to this obesity was also associated with chronic low grade inflammation. Because of this factor, sequestration of iron through inflammatory mediated mechanism may also causes the iron deficiency in obesity (Yanoff *et al*., 2007; Menzie *et al*., 2008) .

Decreased Hb content of RBC causes a decreased oxygen carrying capacity of blood and there is inadequate pumping of the heart. Hence, the persons with anemia have dyspnea, palpitation and angina-like symptoms on strenuous work (Sharma and Gupta, 2016).

Glucose concentration in all the obese populations were significantly higher (p<0.01) (237.33±76.83) than (104±18.16) in healthy groups. Impaired glucose tolerance was observed in a significant number of patients. This category of patients would be at high risk for developing cardiovascular diseases and diabetes (Skora *et al*., 2013).

Obesity was associated with many medical, psychological and social conditions and the most frightful was type 2 diabetes. Both type 2 diabetes and obesity were linked with insulin resistance. In type 2 diabetes, endothelial dysfunction was accompanied with obesity/ insulin resistance in diabetes and prediabetes conditions (this includes people with impaired glucose tolerance and/or impaired fasting glucose).

In addition lifestyle variations such as increased carbohydrate intake and physical activity, are associated with insulin sensitivity fluctuations. Obesity will be considered as the most important factor in the development of metabolic diseases. Metabolism was affected due to adipose tissue and its secretion of hormones, glycerol, and other substances including leptin, cytokines, adiponectin, and proinflammatory substances, and by releasing NEFAs. In obese individuals, the secretion of these substances will be increased (Kasuga, 2006; Lopez *et al*., 2015).

Increased level of Urea level was also noticed (P<0.001) in obese (34.6 ± 8.02) than healthy controls (23.03 ± 6.9). Urea, commonly referred to as blood urea nitrogen (BUN) when measured in

the blood, is a product of protein metabolism. BUN is considered a non-protein
nitrogenous (NPN) waste product. Amino acids derived from the breakdown of protein are deaminated to produce ammonia. Ammonia is then converted to urea via liver enzymes. Therefore, the concentration of urea is dependent on protein intake, the body's capacity to catabolize protein, and adequate excretion of urea by the renal system (Lopez *et al* , 2015).

Similarly creatinine levels were also in raised conditions ($p<0.001$) in the cases (0.9 ± 0.17) and the healthy controls were found normal (0.8 ± 0.15). There was relationship between serum creatinine and glomerular filtration rate (eGFR) where creatinine level in serum concentrations were increased in serum only when approximately 40–50% of renal parenchyma was reversibly or irreversibly damaged. This may lead to the lack of detection of early stages of acute or chronic kidney failure and therefore it may results in delayed application of detailed diagnostics and the implementation of therapeutic interventions (Khurana *et al.,* 2017).

.Higher level of Total cholesterol ($P<0.001$) were detected in obese (7.87±0.81) and there was no statistically significant raised level of Total cholesterol in non- obese (693±0.64). The study also observed the Higher level ($P<0.01$) of LDL in obese (2.50±0.90) compared to healthy controls (0.43±0.29). In lipid profile TGL, HDL level showed no significant increases in both study groups.

Cholesterol is an important constituent in building cells within the human body. The majority of cholesterol in the body is synthesised in the liver, and the rest are from the dietary sources that we ingest. Unhealthy cholesterol levels will affect blood vessels and cardiovascular system and is a significant risk factor for cardiovascular disease. Elevated LDL cholesterol is strongly related to cardiovascular disease (Seidell, 1995).

Obesity is believed to have a direct effect on metabolic health, since pro-inflammatory cytokines released by the adipose tissue can lead to subclinical inflammation at long-term, even if counterbalanced by anti-inflammatory cytokines. This condition is characterized by a gradual increase in inflammatory markers, such as C-reactive protein, TNF-alpha and interleukin-6, which have a direct relationship with insulin resistance, hepatic steatosis and endothelial dysfunction, leading to atherosclerosis.

Data reported in present study was consistent with observations of previous study who noted BMI (which was natural as per diagnostic criteria), skin fold thickness and abdominal circumference and LDL Cholesterol were higher in obese compared to control group and no significant increase in both study groups done by Rao *et al.,* 2010.

Serum total bilirubin level was significantly ($P<0.01$) higher in cases (0.83 ± 0.25) compared to controls (0.66 ± 0.26). Bilirubin has toxic effects on developing neuronal tissues, and is also a potent endogenous antioxidant and cytoprotectant. The chronic, low-grade inflammation is widely reported to be involved in the mechanism of obesity (Williams *et al*., 1992). An inverse relationship between serum bilirubin and the risk of cardio-metabolic disease has been reported previously in some cross-sectional studies. So the hypothesis was generated that bilirubin has an protective effect relating to metabolic syndrome (Valente, 2009).

Table .1 Clinical Markers for Cases and Controls.

Marker	Control(*n*=30)	Case (*n*=30)	*P* value
Age	18.06 ± 1.5	18.9 ±2.3	0.10
Height	152.3 ± 6.1	158.7 ±8.10	0.001 **
Weight	48 ± 6.3	70.1 ±9.3	0.001**
BMI	20.4 ± 2.3	28.2 ± 3.2	0.001**
Hb	10.5 ± 1.7	12.32 ±3.1	0.01*
Systolic	102.6±10.48	107.3 ± 14.3	0.15
Diastolic	73.33±7.11	72.7 ± 7.8	0.75
Hip waist	32.13 ± 4.80	45.3 ± 5.42	0.001**
Glucose	87.23 ± 13.5	106.6 ± 18.2	0.01*
Urea	23.03 ± 6.9	34.6 ± 8.02	0.001**
Creatinine	0.8 ± 0.15	0.9 ± 0.17	0.001**
TC	178.7 ± 19.5	205.6 ± 39.5	0.001**
TGL	113.4 ± 26.8	116.8 ± 26.0	0.6
HDL	56.8 ± 14.4	64.3 ± 13	0.04
LDL	102.9 ±21.4	121.3 ± 33.1	0.01*
VLDL	22.8 ±4.7	24.3 ± 7	0.32
T.B	0.66 ± 0.26	0.83 ± 0.25	0.01*

Obesity patients(Control) compared with non obesity (Case)
The table shows the mean ± SD, rang in brackets and probability (P).
t-test was used for comparison

LIMITATIONS

Our study has limitations inherent to its retrospective design. Since this was a case control study evaluating the clinical markers of obesity and its associated risk factors and the results do not taken into account some variables, such as the exposure time may induce the factors of the disease. The definition of metabolically healthy obesity was determined based on the identification and exclusion of obesity-related metabolic abnormalities (hypertension, dyslipidemia, diabetes).

Our study group were chosen based on BMI, which, was the most widely used anthropometric variable to characterize obesity, it did not provide information regarding body composition. BMI alone did not give us any insight into this condition. In addition, other anthropometric measures known to provide a more accurate estimation of visceral fat.

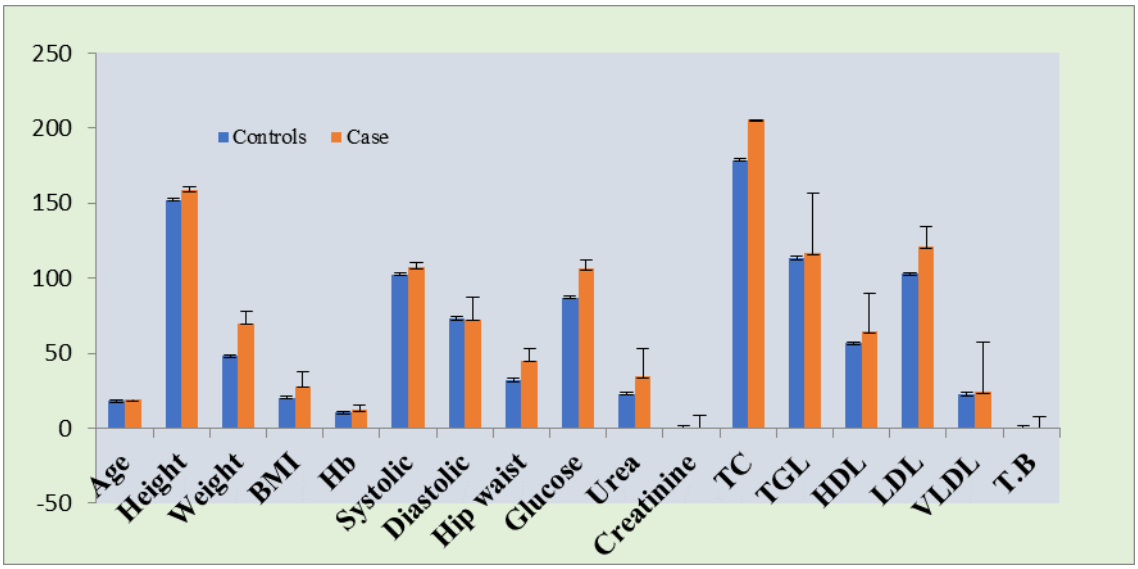

Fig.1. Biochemical Markers of Cases and Controls

CONCLUSION

Obesity widely accepted as one of the most significant risk factor for a wide variety of metabolic conditions such as hypertension, dyslipidemia, and diabetes, which were strongly associated with the development of cardiovascular diseases.

The present retrospective study screened and compared the biochemical markers of obese with non obese healthy controls in the study area. The results affirmed that all the biochemical markers clearly indicated the abnormal level of various clinical parameters in the obese study group.

Obesity is one of the major global problems affecting children and adolescent due to alternation in the diet pattern and lack of physical activity. Overall enerygy imbalance may also be considered as a factor for obesity which may contribute in over accumulation of fat in body leads to DM, hypertension and polycystic ovarian disease etc.

Our pilot study reemphasises that junk foods and sedentary lifestyle are the key risk factors for obesity and also recommend to screen for glucose intolerance, hypertension and dyslipidaemia in obese persons.

In conclusion, overweight/obesity presented a high prevalence in the study area and in order to prevent obesity in this present scenario all the obese persons have to take more care in maintaining the BMI depending upon their age and height and the government has to make policies to arrange health eduction with the goal of promoting indiviudal's health. Because

Obesity has its deleterious effects on every aspects of individual's life not only on health and self esteem but also has its impact on the socio-economic status of the personality. The data of this kind of study and other relevant studies should be utilized to elaborate and put into practice for making policies in the areas of public health, education, socio-economic development, transport, sport and leisure aimed to tackle obesity and maintain a good healthy metabolic profile.

Incorporating Proper diet and physical exercise is the ideal method for creating a negative energy balance and consequently losing weight. Medication as a method of treating obesity should be chosen only when the nutritional treatment has been shown to fail. Although medication helps in weight loss and prevents relapse, it has many side effects and the patient still needs to follow a certain diet and exercise.

CONFLICT OF INTEREST:

"The author(s) declare(s) that there is no conflict of interest regarding the publication of this paper."

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