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ASSOCIATION OF FASTING LIPID PROFILE WITH VISCERAL FAT THICKNESS IN OVERWEIGHT AND OBESE CHILDREN

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Abstract

Introduction: Rapid urbanization with lifestyle changes especially unhealthy food habits and lack of physical activity has resulted in an increase in the incidence of chronic diseases all over the world. The study was conducted in the Out Patient Department of Paediatrics, Saveetha Medical College & Hospital, Chennai in accordance with The Declaration of Helsinki. 51 children were included in the study and were equally distributed into 3 groups of 17 each of normal, overweight and obese children. The height, weight, blood pressure, skin fold thickness, waist circumference, hip circumference were measured in the OPD at the first visit. BMI was calculated and plotted as per IAP charts to classify child as obese, overweight or in normal bracket. Subcutaneous fat level and visceral fat level was measured using Ultrasonogram. Fatty liver changes were measured and graded according to the ultrasound classification. **Results:** Majority of obese (80%) children and 30% of overweight children had systolic hypertension which was grade 1 hypertension compared to normal controls. There was a significant correlation between lipid profile – triglyceride and cholesterol among obese children compared to controls. There was significant increase in the abdominal fat (IAAT) in the obese group. It was alarming to find presence of fatty liver change in 76% of children in obese group. **Conclusion:** Early identification of metabolic abnormalities is crucial in overweight and obese children. Paediatricians play an important role in early identification of complications of obesity, counselling and promoting healthier eating habits and encouraging physical activity.

Keywords: Obesity, Overweight, Visceral Fat Thickness, Subcutaneous Fat Thickness, Fatty Liver.

INTRODUCTION

Rapid urbanization with changes in lifestyle especially unhealthy food habits and lack of physical activity has resulted in an increase in the incidence of chronic diseases like hypertension, obesity, type 2 diabetes, dyslipidemias and metabolic syndrome in adults all over the world.

Globally, the prevalence of childhood obesity has risen in recent years. The International Association for the Study of Obesity (IASO) and International Obesity Task Force (IOTF) estimate that 200 million school children are either overweight or obese. (1)

Ogden et al reported that the percentage of obese children in the US (6-11years age group) was 7 per cent in 1980 which increased to 20 per cent by 2008. Parallelly, among adolescents (age groups of 12-19 years) obesity rates increased from 5 to 18 per cent (2).

Recent figures from IOTF showed prevalence rates of overweight/obesity as 40 per cent in both genders in US. (3) In India in children above 5 years, the prevalence of obesity varies between 2 to 8 per cent. Overweight rates were around two times higher than obesity and seem to be more in northern and eastern India than in southern India.(1)In the past two to three decades: national prevalence of overweight and obesity increased almost four times from 4% to 15% . (4)

Intra-Abdominal Adipose Tissue (IAAT) or visceral fat accumulates in early childhood and can be quantified using imaging techniques like ultrasound. IAAT strongly correlates with insulin resistance and abnormal lipid profile in obese children. (5)Increased visceral fat levels expresses higher levels of adipokines involved in inflammation which is related to high fasting glucose, insulin resistance and risk of diabetes. Hence this study has been undertaken to estimate the subcutaneous fat, visceral fat as well as metabolic profile blood glucose and lipid profile in children with overweight and obesity and compare it to normal children. This study will enable us to identify the presence of visceral fat deposition as well as hepatic changes like fatty liver in overweight and obese children which can predispose to development of NAFLD in early adulthood. Early identification of these metabolic abnormalities is essential for early intervention which can prevent the progression of the disease.

MATERIALS AND METHODS

The study was done after obtaining approval from the Institutional Ethics Committee (SMC/IEC/2020/09/025). The study was conducted in the Out Patient Department of Paediatrics, Saveetha Medical College & Hospital, Chennai in accordance with The Declaration of Helsinki. 51 children were included in the study and were equally distributed into 3 groups of 17 each of normal, overweight and obese children.

Inclusion criteria were a) Overweight and obese children according to IAP classification b) Age Group: 5-18 years c) Compared with Normal children (5 – 18 years)

Exclusion criteria were a) Unwilling to Participate b) Chronic Liver Disease c) Children on long term steroids d) Children with known syndromes and chronic illness

In children attending Paediatrics OPD, height and weight were initially measured and BMI was calculated. Height was measured with a stadiometer to the closest 0.1 cm. Weight was measured using an electronic weighing machine to the closest 0.1 kg. BMI was calculated using the formula BMI = Weight in Kg / Height in m^2. BMI was plotted in the IAP BMI chart. The children who were above 23^{rd} adult percentile were considered in the overweight group and those who were over 27^{th} centile were taken as obese. Children between 3^{rd} centile and 23^{rd} adult centile were taken as normal children.

Skin fold thickness was measured in the Triceps region using Harpendens caliper. (6) Waist circumference, hip circumference was measured using non-stretchable measuring tape. (7, 8) Blood pressure was measured using Standard Mercury Sphygmomanometer using appropriate cuff size for each age. (9) Children were recalled the next day after 8 hours of fasting. Blood was collected for estimation of Fasting Lipid profile. 3 ml of blood was collected in a red capped tube after an overnight fasting and the sample was sent for Total Cholesterol, Triglycerides, HDL cholesterol, LDL cholesterol, VLDL cholesterol. 3 ml of blood was also collected in a Sodium Fluoride tube and sent for estimation of Fasting Blood glucose. (10)

Subcutaneous fat level and Visceral fat level was measured using Ultrasonogram. Subcutaneous Fat Measure - Linear probe with frequency of 6-8 Hz was applied to measure abdominal subcutaneous fat, while the probe was kept in the transverse position. The main landmark for doing the abdominal ultrasound was umbilicus. The probe was placed slightly higher than upper edge of the umbilicus. The distance between skin to the external fascia of the abdominal rectus muscle was measured.

The measurement was repeated 3 times and the average value was recorded. (11) Visceral Fat Measure - Curve probe with frequency of 2-7 Hz was applied to measure abdominal visceral fat, while the probe was kept in the longitudinal position. To determine the best place for the measurement, umbilicus was found first and, then, the probe was placed slightly higher than the upper edge of umbilicus. After detecting the lumbar vertebra, which is located at the back of aortic artery, vertical distance between the internal fascia of the abdominal rectus muscle and the anterior wall of the vertebra was measured. The measurement was repeated 3 times and the average value was recorded. (11) Fatty liver changes were measured and graded according to the ultrasound classification. (12)

STASTICAL ANALYSIS

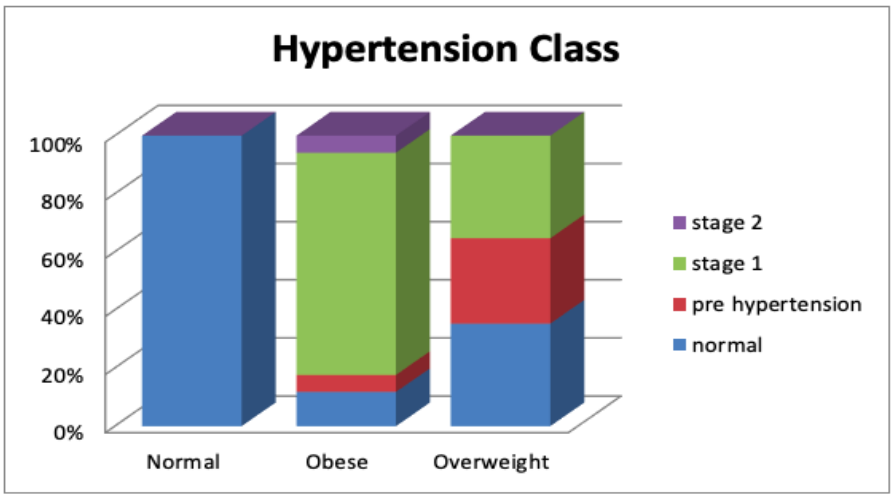
The data was tabulated in Microsoft excel 2010 and statistical analysis was performed in R statistical package version 4.1.1 (10- 08-2021 release) from R Core Team (2021). Descriptive statistics was given by mean and standard deviation. Normality of data was tested with Shapiro-wilk test. For groups that deviated significantly from normal distribution, non-parametric analyses (Kruskal wallis) were performed. For normally distributed data, one way ANOVA was used. For relating BMI with other values, Pearson correlation coefficient was used (Rho). For analyzing the association of gender, socioeconomic status, hypertension class and fatty liver changes with Obese, Normal and overweight groups, chi square test was used. p values less than 0.05 was considered significant for all analyses.

RESULTS

The sample population included 51 children between ages of 5 – 18 years which was taken by consecutive sampling method. Children were categorized into three groups; normal, Obese and Overweight with each group containing 17 children each (1:1:1). Mean age of normal controls were 105 months, mean age of overweight children was 105.59 months whereas mean age of children in obese group was 106.06 months. Age of children in the 3 groups in the three groups were comparable and had no significant variation. Gender distribution amongst the various groups was as follows: 40 % male and 60 % female in normal controls, 38 % male and 62 % female in obese group, 63% male and 37% in overweight category. It showed no significant association of parameters with the groups. Socio economic Status comparison between the 3 groups according to Modified Kuppusamy classification. In normal group13 children were from LMC, 3 from UMC, 1 from ULC whereas in overweight group 12 children were from LMC, 3 from UMC and 2 from ULC Socioeconomic status. Among obese children 12 were from LMC, 4 from UMC and 1 from ULC. There was no significant association of parameter with the groups.

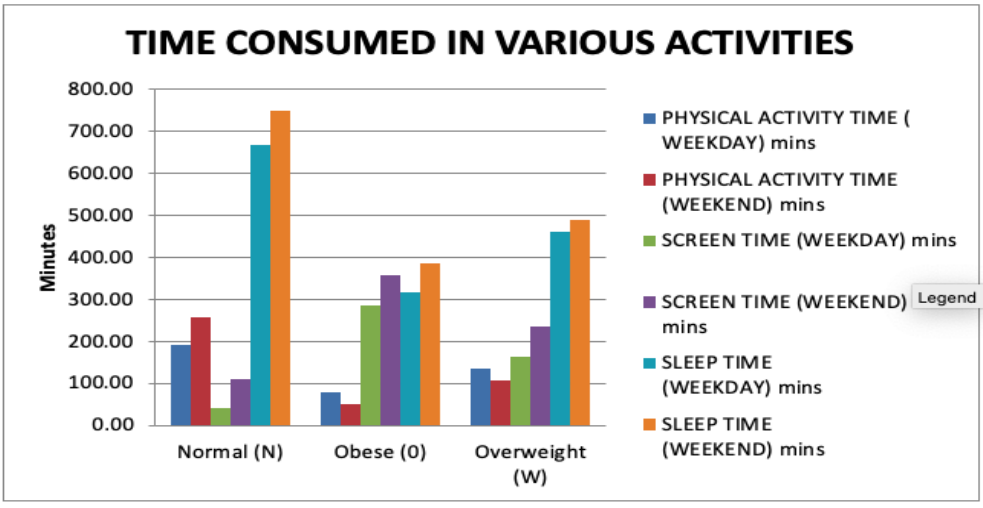
The mean BMI in the normal group was 17.2, obese group was 22.9 and overweight group was 19. This had a statistical significance *(p value < 0.05)* between the 3 groups. The mean skin fold thickness in the obese group was 1.6 cms , normal group 1.5 cms and overweight group 1.52 cm. It was statistically significant. The mean waist hip ratio was 0.96 in the obese group, 0.94 in the overweight group and 0.91in the normal group which was statistically significant. All the children in the normal group had normal blood pressure, 80% obese children had stage 1 hypertension and 30 % overweight children had stage 1 hypertension. 5.8 % of obese group had stage 2 hypertension. (Fig.1).

Figure 1: Showing hypertension staging in the study group. All the children in the normal group had normal blood pressure, 80% obese children had stage 1 hypertension and 30 % overweight children had stage 1 hypertension. 5.8 % of obese group had stage 2 hypertension



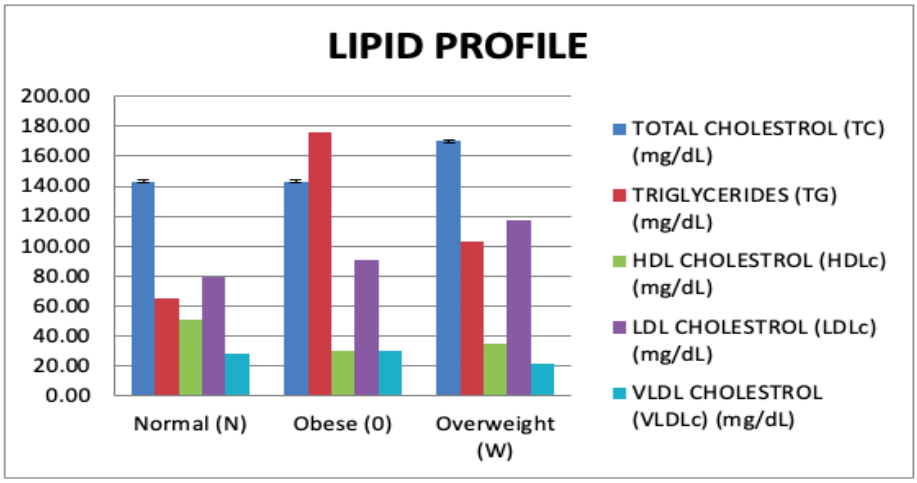
The physical activity was low among obese and overweight children compared to normal children, whereas the screen time was high among obese children compared to normal and overweight children. (Fig.2).

Figure 2: Showing time consumed in various activities in the study group. The physical activity was low among obese and overweight children compared to normal children, whereas the screen time was high among obese children compared to normal and overweight children



HDL – C low in the obese group compared to the normal and overweight group. LDL-C and VLDL – C high among the obese children compared to the normal and overweight children. (Fig.3). Mean fasting Blood glucose was 177.71 mg/dl the obese group, 117.06 mg/dl in overweight group and 88.94 mg/dl in the normal group. Obese group had a mean IAAT of 2.54, overweight group had a mean IAAT 1.39, normal group had a mean IAAT 0.57 and was statistically significant (Fig.4). Control group had no fatty liver changes whereas 23 % of overweight children had fatty liver change and 76% of obese children had fatty liver changes.

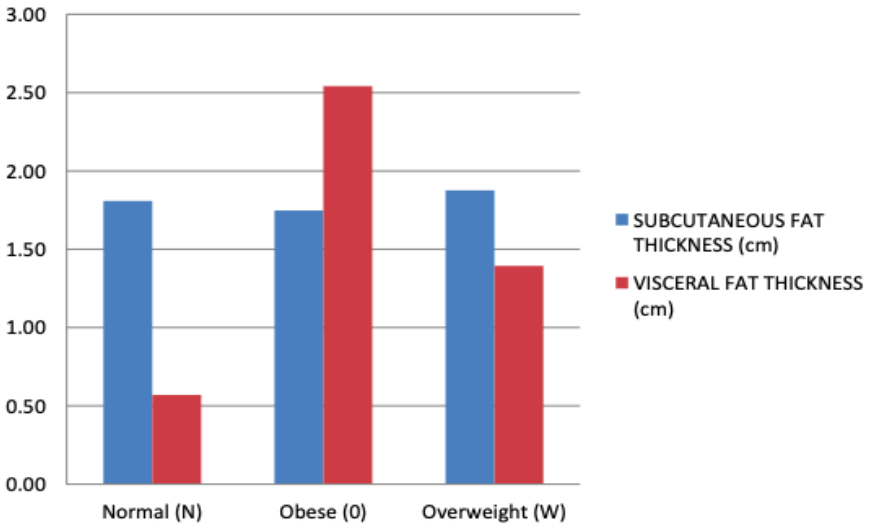
Figure 3: Showing lipid profile in the study group. HDL – C low in the obese group compared to the normal and overweight group. LDL- C and VLDL – C high among the obese children compared to the normal and overweight children



DISCUSSION

Obesity in children is a major health pandemic that is increasing in an alarming rate over the past few years. This might lead to increased chances of cardiovascular complications in the early adulthood and possess a serious threat to the next generation of children. This study was aimed at correlating the fasting lipid profile with the visceral fat level among the overweight and obese children and compare them with normal children to identify if there was increased risk among the overweight and obese children to develop cardiometabolic risks at an early age compared to the normal children.

Figure 4: Showing subcutaneous adipose tissue and intra-abdominal adipose tissue in the study group. Obese group had a mean IAAT of 2.54, overweight group had a mean IAAT 1.39, normal group had a mean IAAT 0.57 and was statistically significant



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Demographic Details

A total of 51 children were included in the study and were separated into three groups as normal, overweight and obese group with each having 17 children aged between 5 – 18 years There was no significant difference in the mean age, gender, socioeconomic status of the children belonging to the three study groups.

BMI

This study was done using the IAP cutoff for overweight and obesity with overweight children taken as greater than 23rd adult centile and obese group taken as 27th adult centile. Vohra R et al did a study using the same cutoff in 407 children at Lucknow and found a prevalence of overweight and obesity 4.17 and 0.73 % respectively (13)

Skin Fold thickness Measurement

The Triceps skin fold thickness was increased in the obese and overweight children compared to children in control group. Skin fold thickness indirectly measures the subcutaneous adipose tissue deposition. It was observerd that the present study was consistent with the study done by Freedman D et al which showed that the BMI correlated with the skin fold thickness which was done in 6866 school children between 1981 – 1994. (14)

In a study by Kenan Sivrikaya et al in Turkey which assessed relationship between BMI and skinfold thickness in exercised and sedentary children they observed that there was high level relation between BMI and skinfold thickness in 9 – 10 year old boys. In Physically active girls the relationship between BMI and skinfold thickness of 9 – 11 years was the highest. However the BMI and skin fold thickness was not correlating in sedentary children (15)

Waist Hip Ratio and Obesity

In this study, children with obesity and overweight had an increased waist hip ratio. This was similar to the previous studies (16) done by Moore L et al which showed that the waist hip ratio was increased in the overweight and obese individuals and was also a marker for increased risk of metabolic syndrome.

Hypertension and Obesity

In this study it was found that children in the obese group had higher percentage of stage 1 and 2 hypertension compared to the normal group, overweight children had Stage 1 hypertension and no Stage 2 hypertension. This was comparable to the study conducted by Schmidts M et al which showed that obesity was associated with hypertension (17)

In a large cohort study of more than 100,000 children and adolescents followed for several years, those with obesity and severe obesity had higher BP at baseline and a greater risk of developing hypertension years later than those of lower BMI categories. Obese children aged 3 to 11 had twofold increased risk of developing HTN compared with healthy weight children (18)

Lipid Profile and Obesity

In this study, fasting lipid profile was found to be deranged in obese and overweight group which was similar to the study done by Friedland O et al, which was done in USA showed increase in the total cholesterol and triglyceride among the obese

children who took part in the study. Our study showed increased mean cholesterol value of 170.35 mg/ dl in obese children and the mean value was normal in overweight and control group. The mean triglyceride was increased to 170.6 mg/dl and HDL was decreased in the obese group. (19)

In a study by Riccardo Fiorentino et al it was found that physical activity and weight reduction are the corner stones of preventing and treating lipid abnormalities in children. Weight management must be done for children with altered lipid profile in obese and overweight since it is a risk for adverse cardiometabolic effects later on in life. The mechanism by which physical activity decrease lipid level is by improving insulin sensitivity, enhancing activity of Lipoprotein lipase and by reducing Free fatty acid release from adipose tissue(20)

Adipose Tissue Measurement and Obesity

This study showed that there was a significant difference in the visceral fat level (IAAT) among the overweight and obese children compared to the normal children. This was similar to the study done by Yan Y et al which was done with 8460 children, which showed correlation between increased visceral fat thickness in the obese children and also that increased visceral fat thickness was correlating to the cardiovascular risk development (21)

Compared to subcutaneous fat, visceral fat is more dangerous as it enters the portal circulation directly and can deposit in liver and other blood vessels leading to atherosclerosis.

Fatty Liver change and Obesity

This study showed fatty liver change in 23 % of overweight group and 76 % of obese children. There was no fatty liver changes in normal group. This was similar to study done by Alfani R et al showed that obesity was related to NAFLD.(22) Non-alcoholic steatohepatitis (NASH) occurs when excess fat build up in the childs liver leading to inflammation and cell damage. If this condition not treated appropriately, the condition can progress to fibrosis and cirrhosis and risk of developing liver cancer in future. It is a challenge to treat fatty liver disease as it is mostly asymptomatic in children.

The North American society for paediatric gastroenterology and nutrition has recommended that all children with obesity should be screened for fatty liver disease. Once identified life style modification is essential with proper diet advice that includes less calories, sugar and fat in the diet.

CONCLUSION

- Majority of obese (80%) children and 30% of overweight children had systolic hypertension which was grade 1 hypertension compared to normal controls
- It was alarming to find that the time spent in physical activity was significantly low in overweight and obese children compared to normal group
- Overweight and obese children had a significantly increased screen time compared to normal children
- There was a significant correlation between lipid profile – triglyceride and cholesterol among obese children compared to controls
- There was significant increase in the abdominal fat (IAAT) in the obese group

- It was alarming to find presence of fatty liver change in 76% of children in obese group
- Early identification of metabolic abnormalities is crucial in overweight and obese children. Paediatricians play an important role in early identification of complications of obesity, counselling and promoting healthier eating habits and encouraging physical activity. It is important the whole family to participate in these efforts for it to be successful Identifying fatty liver earlier is crucial since it is asymptomatic in children
- Fatty liver is the gateway to metabolic syndrome including Type 2 DM and hypertension.

Limitation of the study

- Small sample size
- Correlation between diet intake and obesity was not done in the study
- The extent of multiple organ damage resulting due to overweight and obesity was not evaluated in detail in this study

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