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Carotid Intima Media Thickness in Obese Egyptian Children and Adolescent

Zainab Al-Drawny[1], Safaa Hamdy Ahmad Saleh[1],
Ahmad Abdel Aziz El-Sammak[2], Hisham Mahmoud Attia*[1]
Departments of [1]Pediatric and [2]Diagnostic Radiology, Faculty of Medicine, Zagazig University, Egypt.
***Corresponding author:** Hesham Mahmoud Attia**, Telephone**: +201024683929, **E mail**: mosad8rashed@gmail.com

ABSTRACT

Background: Obesity is a significant public health crisis. Carotid artery Intima-Media Thickness (CIMT) is a new noninvasive ultrasound test that is being recommended to screen for heart disease in apparently healthy individuals.
Objective: To determine the relationship between CIMT and obesity in children and adolescents.
Patients and Methods: This study was a cross-sectional study, which was done on 74 obese children aged 6-18 years. This study was done at the Pediatrics Department, Zagazig University Hospitals., during the period from 2017 to 2019. All children were subjected to history taking and clinical examination. Anthropometric measurements were measured. Carotid intima-media thickness quantification was estimated.
Results: The study resulted in 36 females (48.6%) and 38 males (51.4%). Children lived in rural areas 38(51.4%) and urban areas were 36 (48.6%). There was a significant increase in CIMT in obese children. Statistically significant positive correlations were observed between CIMT and BMI. Statistically significant positive correlations between CIMT and total cholesterol, triglycerides, while no statistically significant correlations were observed between CIMT and LDL, and HDL.
Conclusion: There is a relationship between CIMT and obesity in children of the target population of the study and, at the same time, there also exist statistically significant positive correlations between CIMT and total cholesterol, triglycerides, and no statistically significant correlations between CIMT and LDL, and HDL. Regarding the prevalence of insulin resistance (IR) among our studied children, we found that 31 patients were IR (41.9%), while 43 were not (58.1%). Insulin resistance (IR) was statistically higher in children with CIMT > 0.5 millimeters.
Key words: Carotid Intimamemdia Thickness, Obese, Children, Adolescents

INTRODUCTION

Obesity is an important public health crisis all over the world [(1)]. The prevalence of obesity is more than doubled between adults (rising from 15% to 34%), and also more than three times as in children and adolescents (rising from 5% to 17%) [(2)]. Childhood obesity is always associated with many diseases, especially cardiovascular diseases, diabetes mellitus type 2, obstructive sleep apnea, some types of cancer, and osteoarthritis. For that, obesity has been found to reduce life expectancy [(3)].

Carotid artery Intimamedia Thickness (CIMT) is considered a new noninvasive ultrasound test which is recommended by the American Heart Association and the American College of Cardiology as has a role in screening for heart disease in all individuals [(4)].

Touboul *et al.* [(5)] demonstrated that obese children present higher values in the CIMT and, at the same time, have more cardiovascular complications throughout their lives.

Schiel *et al.* [(6)] found a significant association between carotid IMT and weight, BMI, BMI-SDS, blood pressure, as well as various other metabolic parameters.

Abdel-Wahab *et al.* [(7)] concluded that obesity in childhood and adolescents is associated with subclinical atherosclerosis.

Borda *et al.* [(8)] determined the relationship between CIMT and obesity in children. They found a relationship between CIMT and obesity in children and a direct relation between CIMT and abdominal perimeter.

AIM OF THE WORK

This work aimed to determine the relationship between CIMT and obesity in children and adolescents.

PATIENTS AND METHODS

This study was a cross-sectional study, which was done on 74 obese children aged 6-18 years. This study was done at the Pediatrics Department, Zagazig University Hospitals., during the period from 2017 to 2019.

Inclusion criteria: Obese children aged 6-18 years were chosen (their body mass index which exceeds the age- gender-specific 95th percentile.

Exclusion criteria: Obese children with genetic syndromes, Children receiving any medications like hormonal or corticosteroids, Children with endocrinal disorders as diabetes mellitus. Children with hypertension and Children with chronic illness and

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physical disability to exclude the effect of possible comorbidities of obesity.

Ethical approval and written informed consent:
An approval of the study was obtained from Zagazig University academic and ethical committee.

Every patient signed an informed written consent for acceptance of the operation.

History taking included (Age, sex residence, and socioeconomic level).

Anthropometric measurements included:

Weight which was measured in light clothing without shoes and socks to the nearest 0.1 kg using a pre-calibrated body impedance analyzer. **Height:** was measured without shoes to the nearest 0.1 cm using a calibrated stadiometer (RAVEN EQUIPMENT LIMITED, ENGLAND). **Body Mass Index (BMI):** It equals weight in kilograms over height in meters square (BMI = Wt /ht^2) **[9]**.

Waist Circumference: was measured at the minimum circumference between the iliac crest and the rib cage using a tape measure.

Carotid intima-media thickness quantification. was measured by B-mode ultrasound using a 10-MHz linear transducer (Philips HD7).

The subjects were examined supine with the neck extended and the probe in the anterolateral position. All measurements of IMT were made in the longitudinal plane at the point of maximum thickness on the far wall of the common carotid artery along a 1 cm section of the artery proximal to the carotid bulb.

The IMT was defined as the distance between the intima-blood interface and the adventitia-media junction. After freezing the image, the measurements were made using electronic calipers. The maximal thicknesses of the intima-media width were measured to give three readings and the mean value was used for statistical purposes.

Laboratory investigations:

- Fasting blood glucose: Done by kits pushed from the biotechnica instrument, Roma-Italy, with LOT Number is 000566, using Biosystem AIA Autoanalyser.
- METHOD: Colorimetric enzymatic method GOD-POD.
- Fasting blood insulin: Done by kits pushed from Monobind, USA, its LOT Number is #EIA-58K1K5, using ELISA Best-2000 Reader. TEST PRINCIPLE: The Insulin Quantitative Test Kit is based on a solid phase enzyme-linked immunosorbent assay.
- Fasting blood Triglyceride: Done by kits pushed from the biotechnica instrument, Roma-Italy, with LOT number is 000276, using Biosystem AIA Autoanalyser.
- Cholesterol: Done by kits pushed from biotecnica instrument, Roma-Italy, with LOT number is 000116, using Biosystem AIA Autoanalyser.
- METHOD: Colorimetric enzymatic method CHOD-PAP.
- HDL Cholesterol: Done by kits pushed from AMS U.K. Ltd, United kingdom, with LOT number is A8635, using Biosystem AIA Autoanalyser.
- METHOD: IMMUNOINHIBITION.
- LDL Cholesterol: LDL-C is most often measured indirectly, using a calculation based on other blood lipid analytes. Friedewald calculation incorporates total cholesterol, HDL-C, and triglyceride :
- LDL-C (mg/dl)=total cholesterol – HDL-C – (triglycerides/5).
- HOMA was calculated by multiplying the value of fasting insulin and fasting glucose and divided by 22.5. The score of ≥4.0 was classified as insulin resistance, while a score of less than 4.0 was considered as insulin sensitive **[10]**.

HOMA-IR=
$$\frac{Glucose\ x\ Insulin\ /\ (Glucose\ in\ molar\ unit\ mmol/l)}{22.5}$$

Statistical analysis

Recorded data were analyzed using the statistical package for social sciences, version 20.0 (SPSS Inc., Chicago, Illinois, USA). Quantitative data were expressed as mean± standard deviation (SD). Qualitative data were expressed as frequency and percentage .The following tests were done: Independent-samples t-test of significance was used when comparing two means. Chi-square (X^2) test of significance was used to compare proportions between qualitative parameters. Pearson's correlation coefficient (r) test was used to assess the degree of association between two sets of variables. P values < 0.05 were considered statistically significant.

RESULTS

Table (1): Demographic data of the studied children (Number=74)

		Range	Mean+SD
Age (years)		8 - 15	11.70 + 1.66
		NO.	**%**
Sex	Male	38	51.4
	Female	36	48.6
residence	Urban	36	48.6
	Rural	38	51.4
socioeconomic	HIGH	32	43.2
	MILD	38	51.4
	LOW	4	5.4

This table shows demographic data of the studied sample, the mean of age was 11.7 + 1.66 years. The male percentage was (51.4 %) and the female percentage was of the urban residence (48.6 %) **(Table 1).**

Table (2): Anthropometric measurements, fasting insulin, glucose, and lipid profile of the studied children (Number=74)

Anthropometric measurements	Range	Mean+SD
Weight (kg)	48 - 85	67.46 + 8.47
Height (cm)	117 - 160	143.11 + 8.79
Waist (cm)	60 - 105	88.41 + 9.75
Hip (cm)	50 - 103	77.1 + 15.5
BMI(Kg/m^2)	30.10 - 36.70	32.03 + 1.88
Z.score (SD)	0.80 - 4.80	2.14 + 1.13
waist/hip	0.70 - 6.40	1.86 + 1.17
Fasting insulin (µ/ml)	2.80 - 21.50	10.70 + 4
Fasting glucose (mg/dl)	64-88	77.7+ 7
Serum cholesterol (mg/dl)	118 - 227	174.2 + 28.2
Serum triglyceride (mg/dl)	27 - 220	114.30 + 40.765
HDL (mg/dl)	30 - 73	48.62 + 9.44
LDL (mg/dl)	52 - 160	103.75 + 28.79

This table shows that, Weight values ranged between 48 and 85 with a mean of 67.46 + 8.47, Height (cm) values had mean of 143.11 + 8.79, BMI (Kg/m^2) values ranged between 30.10 and 36.70with a mean of 32.03 + 1.88, Z. score (SD) values ranged between 0.80 and 4.80with a mean of 2.14 + 1.13, waist/hip values ranged between 0.70 and 6.40with a mean of 1.86 + 1.17.

Fasting insulin (µ/ml) of the studied children ranged between 2.80 and 21.50 with a mean of 10.70 + 4. Mean value of fasting glucose (mg/dl) was 77.7. Serum cholesterol (mg/dl) values ranged between 118 and 227 with a mean of 174.2 + 28.2, Serum triglyceride (mg/dl) values ranged between 27 and 220 with a mean of 114.30 + 40.765, HDL (mg/dl) values ranged between 30 and 73 with a mean of 48.62 + 9.44, LDL (mg/dl) values ranged between 52 and 160 with a mean of 103.75 + 28.79 **(Table 2).**

Table (3): Prevalence of IR among the studied children.

Variable		No. (N=74)	% (100%)
Insulin resistance	**Non-IR**	43	58.1
	IR	31	41.9

This table shows that the Prevalence of IR among the studied sample was (41.9%) **(Table 3).**

Table (4): Descriptive statistics of the studied children regarding CIMT (millimeter).

	Range	Mean+SD	Median
Right CIMT (millimeter)	0.11 - 0.7	0.42 + 0.16	0.4
Left CIMT (millimeter)	0.12 - 0.7	0.43 + 0.15	0.4
Average CIMT (millimeter)	0.1 - 0.7	0.42 + 0.16	0.4

This table shows that CIMT (millimeter), ranged between 0.1 and 0.7 with a mean of 0.42 + 0.16 **(Table 4).**

Table (5): Correlation between CIMT and other data.

CIMT	Pearson's correlation	
	r	p
Age (year)	0.152+	0.196
Weight (cm)	0.142+	0.228
Height (cm)	0.154+	0.189
Waist (cm)	0.012+	0.921
Hip (cm)	-0.043-	0.716
BMI (Kg/m^2)	0.249+	0.032*
Z.score (SD)	0.356+	0.002**
Waist/hip (μ/ml)	-0.045-	0.702
F insulin (mg/dl)	-0.205-	0.080
Serum cholsterol (mg/dl)	0.368+	0.001**
Serum triglyceride (mg/dl)	0.313+	0.007**
HDL (mg/dl)	-0.148-	0.207
LDL (mg/dl)	-0.073-	0.539

There were statistically significant positive correlations between CIMT and (BMI, Z.score, serum cholesterol, and serum triglyceride). There were no statistically significant correlations between CIMT and other variables **(Table 5).**

Table (6): Frequencies of CIMT (millimeter) among the studied subjects.

		No.	%
CIMT categories	< 0.5	62	83.8 %
	> 0.5	12	16.2 %

Frequencies of CIMT (millimeter) among the studied subjects, < 0.5 were 62 (83.8 %) and > 0.5 were 12 (16.2 %) **(Table 6)**.

DISCUSSION

Our study included 36 female (48.6%) and 38 male (51.4%). **Jagadesan *et al.*** [11] found that the prevalence of obesity was higher in girls than boys. **Shabana and Vijay** [12] found the prevalence of obesity was higher in girls than boys.

Our study showed that children who lived in rural areas were 38(51.4%) and in urban areas were 36 (48.6%). In a study among 340 female adolescents living in Cairo and surrounding rural areas, 35 percent of the girls were overweight and 13 percent were obese. Overweight was more prevalent in urban girls than in rural girls and more prevalent in girls with a higher socioeconomic standard than in those with lower socioeconomic status [13]. This growing trend can be due to improved accessibility and affordability of both junk foods and motorized transport technologies leading to greater ingestion of energy-dense foods, combined with reduced physical activity in the lower-income community [14].

The results of this study revealed that there was a significant increase in CIMT in obese children. **Kandil *et al.*** [15] found higher values of CIMT was found in obese children compared to controls ($p < 0.05$). **Arenas *et al.*** [16] found a significant difference in the CIMT between healthy and obese children diagnosed by BMI. In 2001 French investigators **Tounian *et al.*** [17] described an increase in arterial wall rigidity of common carotids in 48 obese children as compared to controls.

Our study showed that there were statistically significant positive correlations between CIMT and BMI, which is in agreement with other studies [18]. Exposure to cardiovascular risk factors (hypertension, hyperlipidemia) in obese children may induce changes in the arteries, thereby contributing to impaired endothelial function [19].

Our study demonstrated statistically significant positive correlations of the CIMT with BMI. Higher CIMT was significantly associated with increased BMI. Obesity and CIMT may share common genetic factors [20].

This coincides with the results of previous investigators who demonstrated that a higher BMI was strongly associated with increased CIMT [6]. On the other hand, **Giannini *et al.*** [21] did not find such a relation.

Such an association of CIMT was not observed in overweight patients in a longitudinal follow-up study by **Freedman *et al.*** [22]**,** who found that CIMT was not increased among overweight children, which was against the findings demonstrated by other investigators who observed impaired endothelial function in healthy overweight children compared to controls as assessed by BMI and expressed by increasing left CIMT [23]**.**

Our study demonstrated statistically significant positive correlations between CIMT and total cholesterol, triglycerides, and no statistically significant correlations between CIMT and LDL, and HDL.

This agrees with **Martos *et al.*** [24] who described elevated values for CIMT in obese children and the relationship with alterations in their lipid profile, inadequate vasodilation mediated by flow, and a direct relationship with AP. These children became very high cardiovascular risk patients when associated with other risk factors such as arterial hypertension, low-grade inflammation, and sedentarism.

Elkiran *et al.* [25] also found significant differences in 64 obese children and 24 overweight children in comparison with healthy children in the CIMT and AP values with a positive correlation between CIMT and the AP and MBI values. These authors suggest that the AP is associated with cardiovascular complications and is a useful indicator of central obesity, so AP should be quantified in all epidemiological studies that include pediatric obese patients. These findings present some similarities with the results of this study. However, there exists the limitation of not having biochemical markers measured in the blood to establish relationships between CIMT and insulin resistance levels and low-grade inflammation.

Our study showed that WC was not correlated with IMT which agreed with **Hacihamdioğlu *et al.*** [26] found that WC was not correlated with IMT.

When studying the prevalence of IR among our studied sample, we found that 31 patients were IR (41.9%).

This agreed with **Iwani *et al.*** [10] who aimed to investigate the usefulness of triglyceride to HDL-C ratio (TG: HDL-C) as insulin resistance (IR) marker for overweight and obese children. A total of 271 blood samples of obese and overweight children aged 9–16 years of whom 49% of children were found to have IR as defined by HOMA-IR ≥4.0

This study showed that IR was statistically higher in children was CIMT > 0.5 millimeters.

This agreed with **Huang *et al.*** [2] who found, IR was statistically higher in children with a high level of CIMT.

Limitation of the study: small numbers of patients and lack of sufficient studies in the subjects of the research in children.

CONCLUSION

There is a relationship between CIMT and obesity in children of the target population of the study and, there are statistically significant positive correlations between CIMT and total cholesterol, triglycerides, and no statistically significant correlations between CIMT and LDL, and HDL Regarding Prevalence of insulin resistance (IR) among our studied children, we found that 31 patients were IR (41.9%). IR was statistically higher in children was CIMT > 0.5 millimeters.

RECOMMENDATION

Further studies on different age groups in different areas in Egypt are mandatory.

Conflict of interest: The authors declare no conflict of interest.

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