The Egyptian Journal of Hospital Medicine (October 2021) Vol. 85 (2), Page 3491-3497

Screening of Dyslipidemia and Obesity among Children in Zagazig University Hospitals

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ABSTRACT
Background: Westerners are well aware of plasma lipid problems, which are becoming increasingly important in the Middle East. The European Expert Panel has advocated universal screening as a preferable approach of hypercholesterolemia screening as a part of the primary preventive effort. **Objective:** To assess the relation between dyslipidemia and its risk factors; age and body mass index. **Patients and Methods:** A cross-sectional study that included 357 of children who visited the Pediatrics General Outpatient Clinic at Zagazig University Hospitals. All subjects were subjected to full history taking, general examination, anthropometric measurements, blood pressure, and laboratory investigations including: non-fasting and fasting lipid profiles. **Results:** Non-fasting total cholesterol (TC) of ≥ 200 was (14.3%) and < 200 was (85.7%). Non-fasting (LDL) of ≥ 130 was (16.8%) and <130 was (83.2%). HDL category of < 40 was (61.3%) and ≥ 40 was (38.7%). There was no statistically significant difference between age, sex and lipid profiles. There was statistically significant positive correlation between non-fasting triglycerides (TG) and non-fasting HDL and non-fasting non-HDL-C. **Conclusion:** Obesity was associated with the prevalence of at least one abnormal lipid level. This highlights the importance of paying greater attention to the prevention of cardiovascular disease and obesity in children from an early age.
Keywords: Dyslipidemia, Obesity, Children.

INTRODUCTION
Unhealthy levels of either lipids (cholesterol and/or fatty acids) or lipoproteins in the blood are known as dyslipidemia [(1)]. Increased triglycerides (TG) and low high density lipoprotein cholesterol (HDL-C) both reflect dyslipidemia. Besides, disturbance in lipid metabolism, as do high total cholesterol (TC), high low density lipoprotein cholesterol (LDL-C), high non-HDL-C, and raised LDL-C [(2)]. It is a well-known Western medical issue that plasma lipid problems are also becoming increasingly important in the Middle East. Lack of clinical investigations and inconsistent definitions and criteria employed by those studies limit estimates. yet the prevalence of plasma lipid abnormalities is high there despite this [(3)].

Atherogenesis, the pathophysiology of most cardiovascular disorders such as coronary, peripheral cerebrovascular and vascular diseases, has been linked to high plasma lipid concentrations in particular cholesterol [(2)]. In children and adolescents, the onset of atherosclerosis can proceed slowly and gradually throughout life. One of the most effective ways to avoid atherosclerosis is to detect dyslipidemia early [(4)]. Reduced mortality from cardiovascular disease can be achieved by managing hypercholesterolemia and other risk factors [(2)].

Many studies show that obesity is a significant risk factor for the development of dyslipidemia in children. In order to assess a person's nutritional state and the likelihood of developing cardiometabolic illnesses, such as dyslipidemia, the body mass index (BMI) is often utilized [(4)]. However, BMI is unable to distinguish between fat and lean mass by definition. As a result, an increased BMI may not always reflect an increase in body fat [(5)].

The risk of developing atherosclerosis and cardiovascular disease in early adulthood is up to 100 times greater in those with familial hypercholesterolemia (FH) who do not receive treatment. In order to prevent hypercholesterolemia from causing other health problems, the National Heart Lung and Blood Institute, the National Lipid Association Expert Panel, and the European Expert Panel recommended universal screening as the best strategy for doing so [(6)].

We aimed at this study to assess the relation between dyslipidemia and its risk factors; age and body mass index.

SUBJECTS AND METHODS
A cross-sectional study that was conducted on 357 children who visited the Pediatrics General Outpatient Clinic at Zagazig University Hospitals.

Ethical approval:
All Parents of participants signed informed consent forms for participation in the study. The study was approved by Zagazig University's Research Ethics Committee (ZU-IRB#6195/12-8-2020). We followed the World Medical Association's Ethical Code for human experimentation (Helsinki Declaration).

Inclusion criteria: Children visiting the Pediatrics General Outpatient Clinic, Zagazig University Hospitals, and aged from 2 to 11 years old.

Exclusion criteria: Children whose parents unwilling to participate, post-surgical patients, patients with

Received: 17/8/2021
Accepted: 27/9/2021

autoimmune disorders, malignant neoplasia, acquired immunodeficiencies and chronic diseases e.g. DM and CKDs, patients who were taking medications or had a diagnosis that affect lipoprotein level, and patients who were febrile.

All participants in this study were subjected to the following:

1-History Taking:

Personal History: Age in years, sex, residence (rural, urban), and passive smoking.

Family history: First degree parents with premature coronary artery disease, second degree parents with premature coronary artery disease, first and/or second-degree parents with premature coronary artery disease, parents with TC ≥ 240 mg/dl, parents with diabetes, and parents with hypertension.

2-Clinical Examination: Weight, height, body mass index, waist circumference, and blood pressure.

3-Laboratory Investigations:

Non fasting lipid profile: After a 12-hour overnight fasting and a typical diet, non-fasting venous blood samples (10 ml) were collected from the antecubital vein in suitable vacutainers and transported under refrigeration for analysis. For ten minutes at 900 g, blood samples were centrifuged at 4°C. The enzymatic colour test and non-HDL cholesterol were used to quantify serum triglycerides (TG), total cholesterol (TC), and high-density lipoprotein cholesterol (HDL-C). Non-HDL-C was calculated (non-HDL-C = TC - HDL-C). The Friedewald equation was used to figure out how much cholesterol in the blood is low density lipoprotein (LDL-C). LDL-C = TC – (TG/5 + HDL-C). An enzymatic colorimetric technique was used to determine the concentration of TC.

Fasting lipid profile:

There was an increased risk in the high-risk group (Children who had non-HDL-C levels greater than 145 milligrams per deciliter) who were subjected to 12-hour fasting blood sampling and re-measurement of serum triglycerides (TG), total cholesterol (TC), and high-density lipoprotein cholesterol (HDL-C).

Statistical analysis

Statistical package for social science (SPSS) was used to code, enter, and process the data (version 18). The findings were presented in tabular and diagrammatic formats, and then they were discussed. As descriptive statistics, the mean, standard deviation, range, frequency, and percentage were all calculated. The following tests were used: The Chi-Square test X^2, the Student's t test, and the Pearson's Product correlation coefficient. P value ≤ 0.05 was considered significant.

RESULTS

Regarding sex, 48.7% of subjects were females and 51.3% were males and regarding residence 60.2% were rural and 39.8% were urban. Regarding age groups, 69.7% were 2-9 years and 30.3% were 9-11 years. Regarding age, it ranged between 2 and 12 with mean 6.32 ± 3.10 and median 6. Table (1) showed that weight for age Z- score among the studied cases, 0.3% were < -2, 85.4% were -2:2 and (14.3%) were > 2. Height for age Z- score among the studied cases, 100% were -2:2. Blood pressure for height percentile among the studied cases, 50 was the majority by 46.2%. Body mass index for age Z- score among the studied cases, 85.6% were -2:2 and 14.3% were > 2. Waist circumference for height percentile among the studied cases, 50 was the majority by 57.4%.

Table (2) showed that non-fasting total cholesterol (TC) of ≥ 200 was 4.3% and < 200 were 85.7%, HDL categories of < 40 were 61.3% and ≥ 40 were 38.7%, non-fasting (LDL) of ≥ 130 were 16.8% and < 130 were 83.2% non-fasting non HDL-C of ≥145 were 20.7% and < 145 were 79.3% and non-fasting triglycerides (TG) ranged between 32 and 538 with mean of 110.13 ± 67.69).

Table (3) showed that there was no statistically significant difference between dyslipidemia and no dyslipidemia regarding demographic data.

Table (4) showed that the percentage of weight for age Z- score was statistically higher among dyslipidemia than no dyslipidemia [(0.4% and 0.0% respectively) P= 0.022]. There was no statistically significant difference between dyslipidemia and no dyslipidemia regarding height for age Z- score. There was no statistically significant difference between dyslipidemia and no dyslipidemia regarding blood pressure for height percentile. The percentage of body mass index for age Z- score was statistically lower among dyslipidemia than no dyslipidemia [(83% and 94.1% respectively) P= 0.037]. There was no statistically significant difference between dyslipidemia and no dyslipidemia regarding waist circumference for age percentile.

Table (5) showed that there was no statistically significant difference between males and females regarding lipid profile. In addition, there was no statistically significant difference between age categories regarding lipid profile.

Table (6) showed that there was statistically significant positive correlation between non-fasting total cholesterol (TC) and weight for age Z score, blood pressure for height percentile, body mass index for age Z score, waist circumference for age percentile, non-fasting triglycerides (TG) , non-fasting (HDL), non-fasting (non HDL-C) and non-fasting (LDL). Besides, there was no statistically significant difference between non-fasting total cholesterol (TC) and other numerical data.

Table (7) showed that there was statistically significant positive correlation between non-fasting triglycerides (TG) and non-fasting HDL, and non-fasting non HDL-C. Additionally, there was no statistically significant difference between non fasting triglycerides (TG) and other numerical data.

Table (1): Anthropometric measurements and blood pressure among the studied cases

		No.	%
Weight for age Z- score	**<-2**	1	.3
	-2:2	305	85.4
	>2	51	14.3
Height for age Z- score	**-2:2**	357	100
Blood pressure for height percentile	**10**	27	7.6
	25	77	21.6
	50	165	46.2
	75	54	15.1
	90	14	3.9
	95	14	3.9
	97	6	1.7
Body mass index for age Z- score	**-2-2**	306	85.6
	>2	51	14.3
Waist circumference for age percentile (cm)	**10**	10	2.8
	25	25	7.0
	50	205	57.4
	75	49	13.7
	90	18	5.0
	95	44	12.3
	97	6	1.7

Table (2): Distribution of the studied sample regarding non-fasting total cholesterol (TC), HDL, non HDL C, LDL and non-fasting triglycerides (TG)

	Mean ± SD	
Non-fasting total cholesterol (TC) (mg/dl)	152.71± 44.429	
	No.	**%**
Cholesterol categories	51	14.3
	306	85.7
Non-fasting (HDL) (mg/dl)	37.24± 4.52	
	No.	**%**
HDL categories	219	61.3
	138	38.7
Non-fasting (HDL) (mg/dl)	115.52± 42.38	
	No.	**%**
Non-fasting (non HDL-C) (mg/dl)	74	20.7
	283	79.3
Non-fasting (LDL) (mg/dl)	93.60± 39.54	
	No.	**%**
LDL categories (mg/dl)	60	16.8
	297	83.2
Non-fasting triglycerides (TG) (mg/dl)	110.13± 67.69	

Table (3): Comparison between dyslipidemia and no dyslipidemia regarding demographic data

			Dyslipidemia	No dyslipidemia	X^2	P. value
Sex	**Female**	**No.**	137	37	1.212	.271
		%	50.4%	43.5%		
	Male	**No.**	135	48		
		%	49.6%	56.5%		
Residence	**Rural**	**No.**	167	48	.656	.418
		%	61.4%	56.5%		
	Urban	**No.**	105	37		
		%	38.6%	43.5%		
Age (years)	**Mean ± SD**		6.263 ± 3.10	6.48 ± 3.10	**t. test** (-.584)	.560

Table (4): Comparison between dyslipidemia and no dyslipidemia regarding anthropometric measurements and blood pressure

			Dyslipidemia	No dyslipidemia	X^2	P. value
Weight for age Z- score	**<-2**	**No.**	1	0	16.390	.022
		%	.4%	.0%		
	-2:2	**No.**	225	80		
		%	82.7%	94.2%		
	>2	**No.**	46	5		
		%	16.9%	5.9%		
Height for age Z- score	**-2:2**	**No.**	272	85	5.068	.280
		%	100%	100%		
Blood pressure for height percentile	**10**	**No.**	18	9	9.022	.172
		%	6.6%	10.6%		
	25	**No.**	60	17		
		%	22.1%	20.0%		
	50	**No.**	122	43		
		%	44.9%	50.6%		
	75	**No.**	40	14		
		%	14.7%	16.5%		
	90	**No.**	14	0		
		%	5.1%	.0%		
	95	**No.**	12	2		
		%	4.4%	2.4%		
	97	**No.**	6	0		
		%	2.2%	0%		
Body mass index for age Z- score	**-2:2**	**No.**	226	80	13.428	.037
		%	83%	94.1%		
	>2	**No.**	46	5		
		%	16.9%	5.9%		
Waist circumference for age percentile	**10**	**No.**	5	5	12.312	.055
		%	1.8%	5.9%		
	25	**No.**	17	8		
		%	6.3%	9.4%		
	50	**No.**	153	52		
		%	56.3%	61.2%		
	75	**No.**	40	9		
		%	14.7%	10.6%		
	90	**No.**	12	6		
		%	4.4%	7.1%		
	95	**No.**	39	5		
		%	14.3%	5.9%		
	97	**No.**	6	0		
		%	2.2%	0%		

Table (5): Comparison between male and female, age categories regarding lipid profile

(mg/dl)		Male	Female	t.test	P. value
Non fasting total cholesterol (TC)	**Mean ± SD**	149.60± 4.42	155.97 ± 8.18	-1.356-	.176
Non fasting triglycerides (TG)	**Mean ± SD**	105.64 ± 6.45	114.86 ± 7.56	-1.288-	.199
Non fasting (HDL)	**Mean ± SD**	37.14 ± 4.74	37.35 ± 4.29	-.446-	.656
Non fasting (non HDL-C)	**Mean ± SD**	112.46 ± 8.13	118.74 ± 6.33	-1.399-	.163
Non fasting (LDL)	**Mean ± SD**	91.49 ± 5.84	95.82 ± 4.08	-1.035-	.302
		2-9 years	**9-11 years**	**t.test**	**P. value**
Non fasting total cholesterol (TC)	**Mean ± SD**	152.68 ± 4.89	152.76 ± 5.84	-.015-	.988
Non fasting triglycerides (TG)	**Mean ± SD**	105.90 ± 9.43	119.91 ± 8.19	-1.802-	.072
Non fasting (HDL)	**Mean ± SD**	37.35 ± 4.33	37.00 ± 4.94	.662	.508
Non fasting (non HDL-C)	**Mean ± SD**	115.42 ± 4.09	115.76 ± 4.24	-.070-	.944
Non fasting (LDL)	**Mean ± SD**	94.28 ± 7.88	92.05 ± 4.26	.488	.626

Table (6): Correlation between non fasting total cholesterol (TC) and other data

Correlation	**Pearson's correlation**	
	r	**p**
Age * non fasting total cholesterol (TC)	.033	.535
Weight for age Z score * non fasting total cholesterol (TC)	.158	.003
Height for age Z score * non fasting total cholesterol (TC)	.054	.307
Blood pressure for height percentile * non fasting total cholesterol (TC)	.138	.009
Body mass index for age Z score * non fasting total cholesterol (TC)	.158	.003
Waist circumference for age percentile * non fasting total cholesterol (TC)	.183	.001
Non fasting triglycerides (TG) * non fasting total cholesterol (TC)	.368	.001
Non fasting (HDL) * non fasting total cholesterol (TC)	.494	.001
Non fasting (non HDL-C) * non fasting total cholesterol (TC)	.995	.001
Non fasting (LDL) * non fasting total cholesterol (TC)	.942	.001

Table (7): Correlation between non fasting triglycerides (TG) and other data

Correlation	**Pearson's correlation**	
	r	**p**
Age * non fasting triglycerides (TG)	.094	.077
Weight for age Z score * non fasting triglycerides (TG)	-.018-	.730
Height for age Z score * non fasting triglycerides (TG)	.059	.269
Blood pressure for height percentile * non fasting triglycerides (TG)	-.036-	.502
Body mass index for age Z score * non fasting triglycerides (TG)	-.048-	.369
Waist circumference for age percentile * non fasting triglycerides (TG)	.003	.950
Non fasting (HDL) * non fasting triglycerides (TG)	.256	.000
Non fasting (non HDL-C) * non fasting triglycerides (TG)	.358	.000
Non fasting (LDL) * non fasting triglycerides (TG)	.055	.301

DISCUSSION

Cholesterol problems are well known in the West, and they're becoming more important in the Middle East. Although estimates are hindered by a dearth of clinical research in the region and by variations in the definitions and thresholds employed in the studies that have been undertaken, the prevalence of plasma lipid abnormalities is high in the region [(3)].

People with familial hypercholesterolemia (FH) who are not being treated have a 100-fold greater chance of acquiring atherosclerosis and cardiovascular disease by the time they reach middle age. In order to prevent hypercholesterolemia from causing other health problems, the National Heart Lung and Blood Institute, the National Lipid Association Expert Panel, and the European Expert Panel all recommended universal screening as the preferred technique for hypercholesterolemia screening [(6)].

This study showed that, non-fasting total cholesterol (TC) of ≥ 200 mg/dl was 14.3% and < 200 mg/dl was 85.7%. HDL categories of < 40 mg/dl were 61.3% and ≥ 40 mg/dl were 38.7%. Non-fasting (LDL) of ≥ 130 mg/dl were 16.8% and < 130 mg/dl were 83.2%. Non-fasting non HDL-C of ≥ 145 mg/dl was 20.7% and < 145 mg/dl was 79.3%. Non-fasting triglycerides (TG) ranged between 32 and 538 mg/dl with mean of 110.13± 67.69 mg/dl. This is in agreement with **Klop *et al.*** [(2)] who found overall prevalence of high TC (≥ 200 mg/dL), high non-HDL-C (≥145 mg/dL), high LDL (≥130 mg/dL), high TG (≥100 mg/dL) and low HDL (< 40 mg/dL) was respectively 19.5%, 23%, 19%, 31.8% and 20%. Besides, This agrees with **Bibiloni *et al.*** [(1)] who found the overall prevalence of high TG, non-HDL-chol, TChol, and LDL-chol was 63.0%, 44.1%, 43.5%, and 29.9%, respectively. In addition, this agrees with **Brzeziński *et al.*** [(7)] in which integrated weight loss program for overweight and obese children and adolescents, who wanted to see if there were any lipid issues prevalent. A total of 1948 patients underwent thorough anthropometric and blood work measurements. When it came to overweight and obesity, 38.23% of girls and 40.51% of boys had at least one of the lipid diseases, according to the study. Lipoprotein disorders were more common in those with low HDL cholesterol (found in 20.55% of girls and 23.79% of boys) and those with higher LDL cholesterol (that was present in 15.31 percent of the girls and 14.25 percent of the boys).

This study showed that, non-fasting total cholesterol (TC) of ≥ 200 mg/dl was 14.3% and < 200 mg/dl was (85.7% and non-fasting LDL of ≥ 130 mg/dl was 16.8% and < 130 mg/dl was 83.2%. This agrees with **US Preventive Services Task Force** [(8)] where they intended to bring the 2007 USPSTF screening recommendation for children, adolescents, and young adults with lipid disorders up to date. According to the National Health and Nutrition Examination Survey (NHANES), 7.8% of children aged 8 to 17 have elevated TC levels (200 mg/dL) and 7.4% of teenagers aged 12 to 19 have elevated LDL-C (130 mg/dL) [(9)].

The current study showed that non-fasting LDL of ≥ 130 mg/dl were only 16.8% and < 130 mg/dl were 83.2%. This disagrees with **Lozano *et al.*** [(9)] where the US Preventive Services Task Force asked to conduct a systematic evaluation of the evidence on the benefits and hazards of screening adolescents and children to look for multifactorial dyslipidemia. Dyslipidemia (TC 200 mg/dL or LDL-C 130 mg/dL) and atherosclerosis in infancy; coronary artery disease and stroke in adulthood; diagnostic yield (number of verified cases per children screened); and screening or treatment harms were among the results. Initial screening yield positive predictive value from a study with confirmatory tests was used to calculate simulated diagnostic yield. Study participants with LDL-C levels greater than 130 mg/dL followed a diet that matched current macronutrient recommendations.

This study showed that HDL categories of < 40 mg/dl were 61.3% and ≥ 40 mg/dl were 38.7%. While **Bibiloni *et al.*** [(1)] attempted to determine the prevalence of dyslipidemia and risk variables linked with it in the Northern Mexican child population and their findings conflict with this. They found that The Nuevo León State Survey of Nutrition and Health 2011–2012 enrolled 451 individuals aged 2–10 years old, with girls making up 47.5% of the participants. Although, low HDL-chol levels (35 mg/dL) have also been described as the most common dyslipidemia in other Mexican children and adolescent groups.

In the current work, there were no statistically significant difference between dyslipidemia and no dyslipidemia regarding sex. This agrees with **Marcovecchio *et al.*** [(10)] who found no difference between genders with respect to dyslipidemia. This agrees also with **Brzeziński *et al.*** [(7)] who found that there was no strong association between lipid disorders and sex. While, this disagrees with **Yoon** [(11)] where he tried to find out how common dyslipidemia is among Korean children and adolescents, as well as to look at the diagnosis and treatment options for the condition. He discovered that 25.2% of boys and 21.7% of girls had dyslipidemia, and that the more people were overweight or obese, the more likely they were to have dyslipidemia.

In the current work, there were no statistically significant difference between dyslipidemia and no dyslipidemia regarding age. This agrees with **Brzeziński *et al.*** [(7)] who found that there was no strong association between lipid disorders and age. While, this contradicts with **Bulut *et al.*** [(12)].

This study showed that there was no statistically significant difference between dyslipidemia and no dyslipidemia regarding blood pressure for height percentile. This disagrees with **Boyd *et al.*** [(13)] who found a link between childhood obesity and hypertension and lipid metabolism problems. They also emphasized for the importance of completing lipid

profile screening in all obese children, not only those with hypertension or diabetes [14].

Our study showed that there were statistically significant positive correlation between non-fasting (HDL) and non-fasting non-HDL-C) and non-fasting LDL. This agrees with **Szternel *et al.*** [15] who reported that sd-LDL and non-HDL have such a strong association. The latter can be used as a stand-in for non-fasting lipid indices without paying any further expenses.

The current study showed that there was no statistically significant correlation between non-fasting triglycerides (TG) and BMI. This oppose **Yuan *et al.*** [16] who reported that BMI was most strongly associated with higher triglyceride concentrations, which are not atherogenic and hence do not fit within the diagnosis of multifactorial dyslipidemia.

This study showed that there was a statistically significant positive correlation between non-fasting (LDL) and non-fasting total cholesterol (TC) with body mass index for age Z score. This agrees with **Lozano *et al.*** [9] who found that elevated LDL-C and TC concentrations are associated with higher BMI.

This study showed that there was no statistically significant correlation between non-fasting total cholesterol (TC), non-fasting triglycerides (TG), non-fasting (HDL), non-fasting non-HDL-C and non-fasting (LDL and age. Although there were negative correlations between age and lipid values, these correlations were modest, according to **Brzeziski *et al.*** [7], who discovered that age alone was not a factor significantly separating the group.

This study showed that there was no statistically significant positive correlation between non-fasting total cholesterol (TC), non-fasting non-HDL-C and non-fasting (LDL and weight. According to the results of one study, obesity was more closely associated with negative changes in children's lipid profiles than simply being overweight [17].

CONCLUSION

The prevalence of at least one aberrant lipid level was linked to obesity. This highlights the need of preventing cardiovascular disease and obesity in children as early as possible. Moreover, these data can be used to help develop CVD prevention programs that begin in childhood.

Financial support and sponsorship: Nil.
Conflict of interest: Nil.

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