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Frequency of Hypercholesterolemia and Hypertriglyceridemia in Autistic Spectrum Disordered Children of Bangladesh

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Abstract
Background: *Hypercholesterolemia and hypertriglyceridemia represent metabolic disorders characterized by elevated levels of cholesterol and triglycerides in the bloodstream, respectively. When these conditions manifest in children with autism spectrum disorder (ASD), they pose unique challenges and considerations. This study aimed to assess the frequency of hypercholesterolemia, and hypertriglyceridemia in autistic spectrum-disordered children of Bangladesh.*
Methods: *In a cross-sectional study at Bangabandhu Sheikh Mujib Medical University from March 2014 to January 2015, 100 male children participated—50 in a healthy control group (Group A) and 50 diagnosed with autism spectrum disorder (Group B). Fasting serum levels of various components, calcium, and magnesium were measured. Statistical analyses, including independent sample t-tests and proportion (Z) tests, were conducted, with significance set at P-value <0.05.*
Results: *In this study of 50 autistic spectrum disorder cases, hypercholesterolemia and hypertriglyceridemia occurred at frequencies of 6% and 38%, respectively. Comparing the frequencies of hypercholesterolemia and hypertriglyceridemia between the ASD and control groups, hypercholesterolemia frequencies were 0% and 6% in the control and study groups, with no significant difference. However, hypertriglyceridemia frequencies were 6% and 38% in the control and study groups, respectively, indicating a significantly higher occurrence in the study group (P<0.001).*
Conclusion: *In autistic spectrum-disordered children in Bangladesh, the frequency of hypercholesterolemia is not significantly higher than in healthy children. But, the frequency of hypertriglyceridemia is found to be significantly higher.*

Keywords: *Frequency, Hypercholesterolemia, Hypertriglyceridemia, Autistic spectrum disorder, Children, Bangladesh*

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I. Introduction

In 1943, Kanner detailed autism, describing extreme loneliness and excessive shame in affected children. Kurup and Kurup (2003) [1] linked increased serum cholesterol in ASD children to elevated activity of the rate-limiting enzyme HMG-Co-A reductase. Tierney et al. (2006) [2] found 19% of ASD children had total cholesterol levels below 100 mg/dl. Sikora et al. (2006) reported abnormal cholesterol metabolism in 14 ASD children with lower cholesterol levels. Dziobek et al. (2007) [3] observed elevated triglyceride, LDL, and total cholesterol levels, along with lower HDL, in 22 autistic children compared to controls. Wiest et al. (2009) [4] found elevated levels of total triglyceride (TG), Lys-phosphatidylcholine (LY), and diglyceride (DG) in autistic children compared to the healthy group. Mitochondrial dysfunction, crucial for cellular metabolism, may lead to deficiencies in mitochondrial energy metabolism during periods of increased metabolic demand, contributing to the pathogenesis of autism with abnormal metabolic function (Frye and Rossignol, 2012) [5].

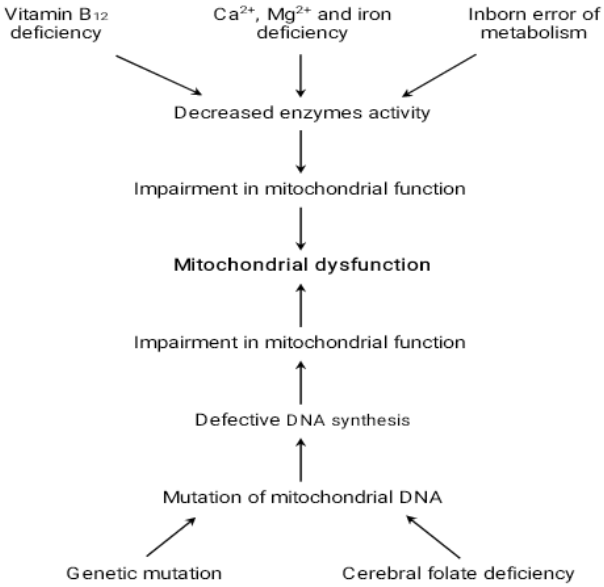

Figure 1: Various causes of mitochondrial dysfunction [6,7].

Mitochondrial dysfunction, particularly deficiency of mitochondrial enzymes, impairs fatty acid oxidation in the mitochondria, disrupting the TCA cycle and hindering the conversion of fatty acids into acetyl-CoA. This disruption leads to reduced NADH and FADH levels, causing a disturbance in the electron transport chain activity and ultimately decreasing ATP synthesis [5]. Conversely, reduced mitochondrial fatty acid oxidation diverts exogenous fatty acids to the esterification pathway, increasing the synthesis and secretion of triglycerides. This alteration is accompanied by an elevation in lipid peroxidation, contributing to oxidative stress and apoptotic cell death through disruption of the plasma membrane and organelles [8,9]. In autism, there is an observed increase in the synthesis of triglycerides and cholesterol attributed to dysfunctional mitochondrial ß-oxidation [3,9]. Another contributing factor to elevated triglyceride levels in autistic children is the consumption of high-sucrose-content foods, which suppress the oxidation of fatty acids by increasing ATP synthesis through carbohydrate combustion. Additionally, continuous intake of dietary fatty acids ultimately leads to increased synthesis of both triglycerides and triglyceride-rich lipoproteins [8].

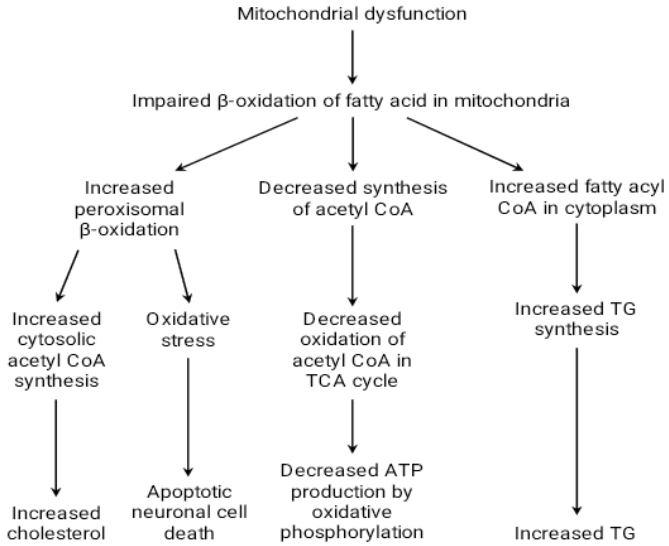

Figure: Flow chart showing impaired mitochondrial β-oxidation leads to increased TG and cholesterol, decreased energy production, and also causes oxidative stress [8,9].

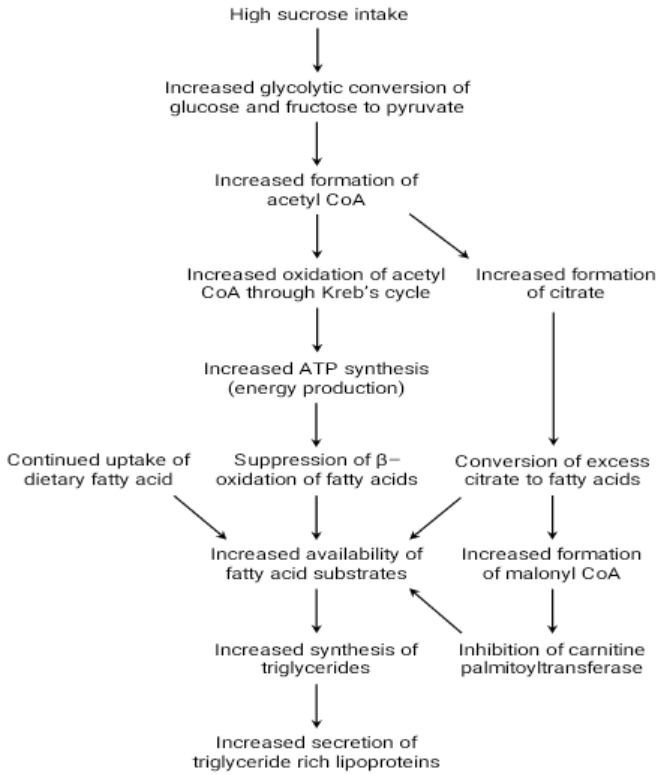

Figure 3: Flow chart showing an increased level of TG due to the high dietary sucrose diet of autistic children [8,10].

It is also thought that autism could result from nutritional deficiencies due to the dietary selectivity of autistic children. Many children with ASD have sensory hypersensitivities and may reject certain foods due to an aversion to texture, smell, temperature, or other characteristics of the food [11].

II. Methodology

This cross-sectional study at Bangabandhu Sheikh Mujib Medical University, Dhaka (March 2014 - January 2015) included 100 male children: 50 healthy controls (Group A) and 50 diagnosed with autistic spectrum disorder (Group B). Institutional Review Board approval was obtained. Autistic children were from the Parents Forum (DOHS, Mohakhali), controls from schools. Inclusion criteria ensured homogeneous autistic males (3-8 years) with a confirmed diagnosis. Healthy controls were matched in age, height, weight, BMI, and sex. Exclusion criteria eliminated confounding factors. The diagnosis was by a pediatric neurologist. Physical examinations and venous blood samples were conducted, analyzing magnesium and calcium levels. Statistical analysis used SPSS 16.0, with a significance set at $P<0.05$.

III. Result

In this study, the mean ±SE age for group A and group B participants were 6.02±0.21 and 16.90±0.73 years, respectively. No significant correlation was found between the groups for age (P=0.94). Similarly, the mean ±SE BMI for group A and group B participants were 5.93±0.22 and 17.25±0.14 Kg/m^2, respectively, with no significant correlation between the groups (P=0.29). The mean (±SE) serum total cholesterol levels were 146±1.70 mg/dl in group A and 145.00±3.77 mg/dl in group B, showing no significant difference between the two groups (P=0.885). However, the mean (±SE) serum triglyceride levels were 86.14 ± 3.28 mg/dl in group A and 107.74±7.91 mg/dl in group B, with significantly higher levels compared to group A ($P<0.01$). In this study, among 50 autistic spectrum disorder cases, hypercholesterolemia and hypertriglyceridemia were observed at frequencies of 6% and 38%, respectively. When comparing the frequencies of hypocalcemia and hypomagnesemia between the ASD and control groups, hypercholesterolemia frequencies were 0% and 6% in the control and study groups, showing no significant difference. However, hypertriglyceridemia frequencies were 6% and 38% in the control and study groups, respectively, indicating a significantly higher occurrence in the study group ($P<0.001$).

Table 1: Demographic status distribution

Group A	Group B	P-value
(n=50)	(n=50)	
Mean ±SE age in (Year)		
6.02 ±0.21	16.90 ±0.73	0.94
Mean ±SE BMI (Kg/m^2)		
5.93 ±0.22	17.25 ±0.14	0.29

Table 2: T. cholesterol & triglyceride status

Group A	Group B	P-value
(n=50)	(n=50)	
Mean ±SD total cholesterol (mg/dl)		
146.16±1.70	145.00 ± 4.34	0.885
Mean ±SD triglyceride (mg/dl)		
86.14 ± 3.28	107.74 ± 7.91	0.007

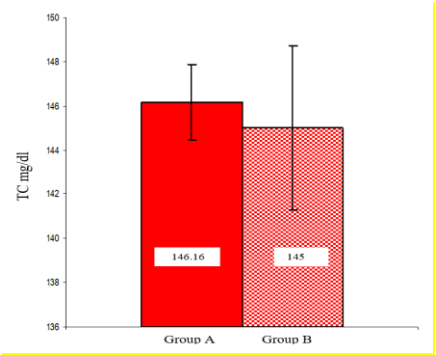

Figure 1: Mean s. total cholesterol status

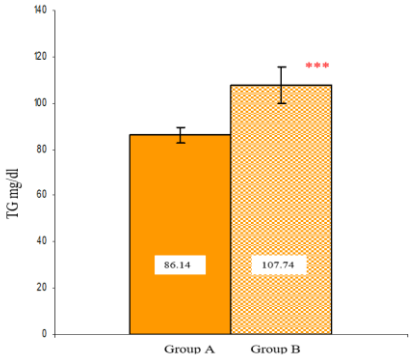

Figure 2: Mean s. TG status

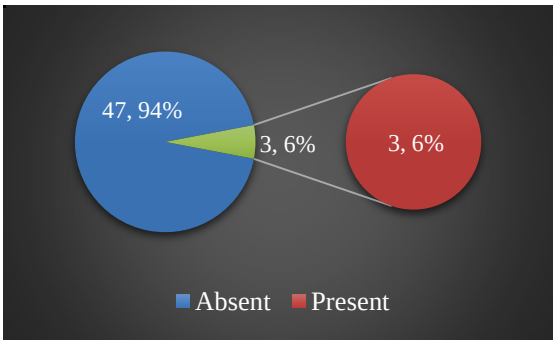

Figure 3: Frequency of hypercholesterolemia in cases group (ASD)

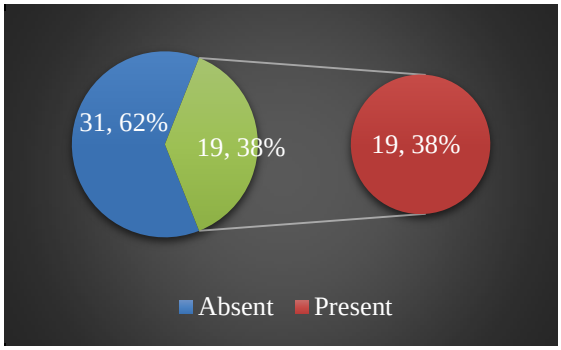

Figure 4: Frequency of hypertriglyceridemia in cases group (ASD)

Table 3: Frequency of hypercholesterolemia and hypertriglyceridemia in two groups

Characteristics	Group A	Group B	P-value
	n (%)	n (%)	
Hypercholesterolemia	0(0%)	3(6%)	>0.05
Hypertriglyceridemia	3(6%)	19(38%)	<0.001

IV. Discussion

This study aimed to assess the frequencies of hypercholesterolemia and hypertriglyceridemia in autistic spectrum-disordered children in Bangladesh. Group A (mean age 6.02±0.21 years) and Group B (mean age 16.90±0.73 years) showed no significant age correlation (P=0.94). Similarly, no significant BMI correlation was found between Group A (mean BMI 5.93 ±0.22 Kg/m^2) and Group B (mean BMI 17.25 ±0.14 Kg/m^2) participants (P=0.29). The mean values of all biochemical variables in normal children fell within physiological limits, closely aligning with findings reported by various researchers [3,12]. Both the control and case groups were comparable, with no significant differences in confounding variables such as age, height, weight, and BMI between the two groups. The mean values of magnesium and calcium were below the lower limit of the normal range. In the present study, serum total cholesterol was not significantly higher in the study group compared to the control group. Similar findings were observed in other studies as well [4,13]. In some studies, serum total cholesterol was reported to be significantly higher in autistic children [1,3], while in another study, it was lower [14]. However, in our study, the serum total cholesterol level was high in only 6% of autistic children (study group) and 0% in apparently healthy children (control group), which was not statistically significant, and there were no similar data available for comparison. Serum triglyceride levels, on the other hand, were significantly higher in the study group than in the control group, consistent with findings from other studies [3,13]. Moreover, abnormally high serum triglyceride levels were observed in 38% of children in the study group and 6% of children in the control group, which was statistically significant. Similar findings of elevated serum triglyceride levels were reported by Kim et al. [13] in 11% of autistic children. Additionally, serum magnesium was significantly lower in the study group than in the control group in this present study. Almost similar findings were observed by Strambi et al. [12]. The serum magnesium level was also found to be abnormally low in 52% of children in the study group and in 4% of children in the control group, which was statistically significant. Kozielec and Hermelin reported that 33.6% of autistic children had magnesium deficiency. In this study, serum calcium was significantly lower in the study group than in the control group, consistent with findings from Ansary et al. [15] and Sun et al. [16]. Moreover, the serum calcium level was abnormally low in 74% of children in the study group and in 6% of children in the control group, which was statistically significant. A similar observation of calcium deficiency in 5.8% of autistic children was reported by Yasuda et al. [17].

Limitation of the study:

Limitations of this study include its single-centered focus and small sample size. Additionally, the research was conducted within a brief timeframe, potentially limiting the generalizability of findings. Consequently, caution is advised in extrapolating results to represent the broader socio-cultural landscape of the entire country.

V. Conclusion

Our study on autistic spectrum-disordered children in Bangladesh reveals that hypercholesterolemia prevalence does not significantly differ from healthy peers. However, a notable increase in hypertriglyceridemia frequency is evident. These findings highlight the unique metabolic profile of autistic children, emphasizing the

importance of targeted health monitoring. Further research is warranted to explore the underlying mechanisms and implications for tailored interventions, fostering a comprehensive understanding of the health challenges faced by individuals within the autistic spectrum in this population.

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Conflict of interest: None declared.

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