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# Alterations in lipid profile of autistic boys: a case control study

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**Abstract**

We hypothesize that autism is associated with alterations in the plasma lipid profile and that some lipid fractions in autistic boys may be significantly different than those of healthy boys. A matched case control study was conducted with 29 autistic boys (mean age, 10.1 ± 1.3 years) recruited from a school for disabled children and 29 comparable healthy boys from a neighboring elementary school in South Korea. Fasting plasma total cholesterol (T-Chol), triglyceride (TG), high-density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C), the LDL/HDL ratio, and 1-day food intakes were measured. Multiple regression analyses were performed to assess the association between autism and various lipid fractions. The mean TG level (102.4 ± 52.4 vs 70.6 ± 36.3; $P$ = .01) was significantly higher, whereas the mean HDL-C level (48.8 ± 11.9 vs 60.5 ± 10.9 mg/dL; $P$ = .003) was significantly lower in cases as compared to controls. There was no significant difference in T-Chol and LDL-C levels between cases and controls. The LDL/HDL ratio was significantly higher in cases as compared to controls. Multiple regression analyses indicated that autism was significantly associated with plasma TG ($\beta$ = 31.7 ± 11.9; $P$ = .01), HDL ($\beta$ = −11.6 ± 2.1; $P$ = .0003), and the LDL/HDL ratio ($\beta$ = 0.40 ± 0.18; $P$ = .04). There was a significant interaction between autism and TG level in relation to plasma HDL level ($P$ = .02). Fifty-three percent of variation in the plasma HDL was explained by autism, plasma TG, LDL/HDL ratio, and the interaction between autism and plasma TG level. These results indicate the presence of dyslipidemia in boys with autism and suggest a possibility that dyslipidemia might be a marker of association between lipid metabolism and autism.


*Keywords:* Autism; Lipids; HDL; LDL; LDL/HDL ratio; Boys

*Abbreviations:* $\beta$, regression coefficient; ASD, autism spectrum disorders; BMI, body mass index; HDL-C, high-density lipoprotein; LDL-C, low-density lipoprotein; $R^2$, total variance explained by a multiple regression model; TG, triglyceride; T-Chol, total cholesterol.

## 1. Introduction

Autism is a frequent and debilitating neurologic handicap in children. Autism spectrum disorders (ASDs) are defined as core abnormalities in reciprocal social interactions and communications and are exhibited as restrictive or stereotypical interests and behavior [1]. In most cases, specific underlying causes cannot be identified. Autism spectrum disorders are complicated conditions in which nutritional and environmental factors play major roles. Significantly, lower levels of various nutrients in blood have been seen in autistic children including low levels of zinc, selenium, vitamin D,

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and ω-3 fatty acids [2,3]. A number of risk factors being investigated include genetic, infectious, metabolic, nutritional, and environmental, with specific causes known in less than 10% to 12% of cases [4,5]. The prevalence of children diagnosed with ASDs has increased significantly over the last decades in the United States and in other countries [6]. Studies conducted in the United States indicate an overall average prevalence of autism in children as 9.0 per 1000 population (95% confidence interval, 8.6-9.3) [7]. Autism is 4 times more common in boys than in girls [7]. In Korean children, the prevalence of autism (2.1/1000) has been reported to be lower than children in the United States [8].

There is evidence that fatty acid metabolism and abnormal membrane fatty acid composition may contribute to neurodevelopment disorders such as autism [9]. However, there is insufficient research regarding the lipid profile of children with autism. Studies have indicated a high prevalence of hypertriglyceridemia in adults in South Korea [10]. Dyslipidemia is elevation of plasma cholesterol (T-Chol), triglyceride (TG), or both, or a low high-density lipoprotein (HDL) level that may contribute to increased risk of atherosclerosis [11]. Because blood lipid levels are measured as continuous variables, there is no definitive natural cutoff between normal and abnormal lipid levels [12]. Because a linear association between plasma lipid levels and risk of cardiovascular disease has frequently been reported, persons with so-called normal T-Chol levels for their age may benefit from achieving still lower levels [12]. Abnormalities in lipid profile in adults with Asperger syndrome, a disorder belonging to the autism spectrum, and various psychiatric disorders have been reported by several investigators [13-16]. A review of current literature resulted in the locating of only one study that evaluated the relationship between autism and T-Chol levels in children [17]. To our knowledge, no studies have been conducted to measure the association between autism and blood lipid profile. This study was conducted to evaluate the lipid profile and dietary intakes of South Korean boys with autism and comparable healthy controls. We hypothesize that autism is associated with the plasma lipids and that some lipid fractions in autistic boys may be significantly different than those of healthy boys. This hypothesis will be tested by the measurement of plasma levels of T-Chol, TG, HDL cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C), and the LDL/HDL in autistic boys and those of comparable healthy boys. Results of this study may provide an indication of presence of hyperlipidemia in boys with autism.

## 2. Methods and materials

### 2.1. Study design and subjects

Cases for this study consisted of 29 autistic boys recruited from a special education school for disabled children located in Seoul (Eunpyung-gu district) in South Korea. Because the prevalence of autism is higher in boys and there were fewer girls enrolled in the special education school, this study was restricted to boys. All the male children diagnosed with autism attending this special education school were invited to participate in this study. Thirty-six eligible cases were identified. Of the eligible cases, 29 boys agreed to enroll in this study. Ages of the cases ranged from 7 to 12 years (mean, 10.1 ± 1.3 years). The diagnosis of autism was based on the American Psychiatric Association *Diagnostic and Statistical Manual of Mental Disorders* III-R and IV criteria [18].

Healthy boys were recruited as controls from an elementary school from the same area as the special education school from which the cases were selected. The elementary school used for recruiting controls was recommended by the staff of local education boards as having children with similar socioeconomic backgrounds to those of the children attending the special education school. Boys with any diagnosed disease were excluded from the control group. To match the average age of cases, grades 2, 3, and 4 were selected from the elementary school for participation in this study. Sixty-nine healthy boys were identified as eligible controls for this study. Of the eligible cases and controls, 29 pairs were matched for the age and body mass index (BMI) range and participated in this study. There was no significant difference in mean age and BMI between cases and controls (Table 1). The socioeconomic status of the children in the 2 groups was assessed by evaluating monthly household income, average food expenditures per month, and the years of education obtained by parents.

Written informed consent was obtained from the parents of both cases and controls. This study was approved by the Institutional Review Board of Gangneung National University. The study period was from December 2002 to March 2003.

Table 1
Demographic characteristics of cases and controls

| Characteristics | Cases, mean ± SD (n = 29) | Range | Control, mean ± SD (n = 29) | Range | $P$ [a] |
|---|---|---|---|---|---|
| Age (y) | 10.1 ± 1.3 | 7.0-12.0 | 10.9.7 ± 2.7 | 10.0-11.0 | .21 |
| BMI | 20.2 ± 4.1 | 13.1-30.2 | 18.6.7 ± 3.2 | 13.9-25.6 | .10 |
| Family income (Wons/mo) | % | | % | | |
| ≤2 000 000 | 55.0 | | 56.5 | | |
| >2 000 000-≤4 000 000 | 35.5 | | 34.1 | | Not significant |
| >4 000 000 | 10.5 | | 9.4 | | |

[a] Student $t$ test and analysis of variance were used to test the significance of difference between case and control variables ($P < .05$).