

The status of dietary fatty acids intake in the autistic children: a case-control study

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Research

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Abstract

Background: Deficiencies or imbalances in dietary fat intake may influence on mental and neurological functions of children with Autism Spectrum Disorders (ASD). This study aimed to compare the amount of fatty acids intake in the autistic cases with the healthy controls.

Methods: This case-control was carried out on 200 randomly selected children (100 autistic cases and 100 healthy controls) in Tehran, Iran. The food frequency questionnaire (FFQ) was used to assess the intake of calorie, macronutrients, and dietary fatty acids including saturated fatty acids (SFA), monounsaturated fatty acids (MUFAs), poly unsaturated fatty acids (PUFAs), linoleic acid (LA), α -Linolenic acid (ALA), eicosapentaenoic acid (EPA), docosahexaenoic acid (DHA), and trans fatty acids.

Results: No significant difference was found in the amount of dietary calorie, protein, carbohydrate, and total fat intake between two groups. In terms of the type of dietary fatty acids, the amount of MUFAs (OR: 3.18(1.13-4.56); $p=0.04$), PUFAs (OR: 4.12(2.01-6.25); $p=0.01$), and LA (4.76(1.34-14.32); $p=0.01$) were significantly higher in ASD children compared to the control group. The amounts of ALA, EPA, DHA, SFA, and trans fatty acid were not significantly different between two groups.

Conclusions: The autistic children had higher unsaturated fatty acids intake except for omega-3 fatty acids. Future longitudinal studies are needed to confirm these findings and to determine the underlying mechanisms of possible associations between unsaturated fatty acids intake and ASD.

Introduction

Autism spectrum disorders (ASD) are neurodevelopmental disorders characterized by poor social communication, repetitive activities, and cognitive and language problems which mainly occurs in childhood. Symptoms of autism are usually recognized between 18 and 36 months of age [1] and can be caused by many different factors that affect the central nervous system [2-4].

The prevalence of ASD has significantly increased in recent years worldwide. Its prevalence in the United States is 14.7 per 1000 children [5]. ASD in Iran is reported to be 1.9% [6]. Many factors may influence the risk ASD disorder such as genetics, immunological factors, biochemical factors, psychosocial factors, maternal smoking, and nutritional factors. Nutritional imbalances may have an important role in ASD and adequate intake of some nutrients may improve behavioral disorders in ADS [7-10].

Poly unsaturated fatty acids (PUFAs) including omega-6 and omega-3 fatty acids are essential for normal growth, cell membrane integrity, and function of central nervous system [8, 10]. Imbalance rates of omega-6 to omega-3 fatty acids may adversely influence the brain function [11-13]. Recent studies indicated that omega -3 polyunsaturated fatty acids can reduce mental and neurological disorders in ASD children [14, 15].

Given the increasing prevalence of autism and the lack of studies on the association between fatty acid intakes and autistic disorders, this study aimed to compare the calorie, macronutrients, and different types of fatty acids intake in autistic cases with the healthy controls in Iranian children.

Methods

Sample characteristics

This case-control study was carried out on 200 children, including 100 autism cases and 100 healthy children aged 5 to 15 years, from March 2018 to January 2019. Autistic children were randomly selected from Autism Charity Center in Tehran, Iran. The controls were selected from the age-matched children who were randomly selected from a nearby high school in Tehran, Iran. Diagnosis of autism in the cases was confirmed by an expert clinician using diagnostic tools including the Autism Diagnostic Observation Scale (ADOS) and the DSM-IV TR criteria for a diagnosis of autistic disorder [15].

The inclusion criteria for the cases included children and their parents' willingness to participate in the study, confirmed diagnosis of ASD, and age from 5 to 15 years. The inclusion criteria for the controls were included no history of neurodevelopmental disorders and age between 5 to 15 years. The exclusion criteria for the cases and controls including consuming macronutrients supplementations, history of allergy, and suffering from diet-related diseases including celiac disease, inflammatory bowel disease, diabetes, blood disorders. General information including age, sex, birth weight, mothers' age, mothers' BMI, and mothers' smoking were collected using general questionnaire. Height was measured using a measuring tape fastened to a wall and without shoes with a nearest 0.5 cm. A bio impedance analysis (BIA) scale (OMRON BF511, Healthcare Co., Kyoto, Japan) was used to measure body weight and body mass index (BMI) of the participants.

Dietary assessment

A validated 168-items semi-quantitative food frequency questionnaire (FFQ) [16] was completed for all participants through a face to face interview with the children's parents. All data obtained from FFQ were converted to grams per day using Iranian household measures reference. Daily intakes of calorie were measured for each person by using the food consumption database of US Department of Agriculture, which was modified for Iranian foods. Macronutrients' consumption frequencies were converted to grams per day by using household measures. The intakes of dietary fatty acids including saturated fatty acids (SFA), monounsaturated fatty acids (MUFAs), poly unsaturated fatty acids (PUFAs), linoleic acid (LA), α -Linolenic acid (ALA), eicosapentaenoic acid (EPA), docosahexaenoic acid (DHA), and trans fatty acids were also assessed.

Statistical analysis

Independent t-test and chi-square tests were used to compare the characteristics between two groups. Logistic regression method was then used to investigate the association of dietary calorie,

macronutrients, and with ASD after adjusting for age, sex, BMI, birth weight, mothers' age, mothers' BMI, and mothers' smoking. The association of the intake of different types of fatty acids with ASD after adjusting for age, sex, BMI, birth weight, mothers' age, mothers' BMI, mothers' smoking, and calorie and macronutrients intake was also assessed using logistic regression method. SPSS version 21 was used for data analyses and $P < 0.05$ was considered as significant.

Results

No significant differences were found between autistic and healthy children in terms of age, sex, BM, mothers' age and mothers' smoking (Table1). The cases had higher birth weight (2938 grams vs 2750 grams; $P=0.01$) and mother's BMI (27.44 kg/m^2 vs 24.5 kg/m^2 ; $P=0.01$) compared to the controls. There was no significant difference between the intake of calorie, protein, carbohydrate and total fat between children with ASD and healthy children (Table2).

Table 3 presents the comparison of dietary fats intake between two groups. The intake of MUFAs (46.11 g/day vs 37.19 g/day ; $P=0.04$), PUFAs (31.20 g/day vs 24.87 g/day ; $P=0.013$), and LA (27.26 g/day vs 22.18 g/day ; $P=0.013$) were significantly higher in the case group compared to the control group. The dietary intake of ALA, EPA, DHA, SFA, and trans fatty acids were not significant different between autistic and healthy children (Table3).

Discussion

The present study found that there were no significant differences between autistic and healthy children regarding weight, height, BMI, and intake of calorie, protein, carbohydrate, and total fat intake. The amount of intake of MUFA, PUFAs, and LA were significantly higher in autistic children. While, intake of omega-3 PUFAs including α -LA, EPA, DHA, and trans fatty acids were not significantly different between two groups.

Previous studies reported contradictory results on the associations between fatty acids intake and ASD. Barnhil et al. investigated the dietary intake of children with ASD and reported that most of these children consumed adequate number of total calories, protein, fats and carbohydrates. However, they had insufficient intake of omega3 and omega6 fatty acids [17]. Moreover, Hyman et al. examined nutrients intake in children with autism and declared that the amount of nutrients intake was similar between children with ASD and the age-matched healthy controls. Only children with the age of 4 to 8 years had lower consumption of energy, vitamin A, vitamin C, and zinc [18]. Windaru et al. reported that ASD children consumed more energy dense foods than typically developed children [19].

Emond et al. investigated the eating disorders, the dietary patterns, and growth in young children with ASD and found that children with ASDs demonstrated eating disorders from their infancy and also they had less food variety compared to the other children. However, their calorie intake and growth were not impaired. They also reported that there was no significant difference between children with ASDs and the

controls in the consumption of protein, carbohydrates, and fats, which was in line with the results of the present study [20]

Mari-Bauset et al. found that children with ASD had lower intake of SFAs and omega-3 polyunsaturated fatty acids (PUFAs). The amount of total PUFAs, PUFAs+MUFAs/SFAs, PUFAs/SFAs, and omega-6/omega-3 ratios were higher than typically developed children [21].

The exact mechanisms of the effects of dietary fatty acids on ASD are not yet clear. Tamiji et al. indicated that dietary intake of PUFA during early development of children with ASD is inadequate and they have higher rates of lipid metabolism. Higher ratio of omega-6 to omega-3 fatty acids in ASD children may be associated with an imbalance in the composition of nervous system fatty acids and potentially led to behavioral disorders which are prevalent in ASD [22]. These results emphasize on the importance of lifestyle modification in improving the behavioral disorders of the ASD.

However, this study had some limitations. Our sample size was small and samples was limited to 5 to 15 years which make it difficult to generalize result to the other age groups. Further studies are needed to increase our understanding of the association of calorie and macronutrients intake, especially dietary fatty acid composition with ASD.

Conclusions

In this study, the autistic children had higher unsaturated fatty acids intake except for omega-3 fatty acids. However, there were no significant differences between autistic and healthy children regarding age, weight, height, BMI, calorie intake, protein intake, carbohydrate intake, and total fat intake between children with autistic and healthy children. Further studies with larger sample size are needed to confirm these findings and to determine the underlying mechanisms.

Abbreviations

FFQ: food frequency questionnaire

PUFAs: poly unsaturated fatty acids

ω -3: poly unsaturated fatty acids n-3 fatty acid

ω -6: poly unsaturated fatty acids n-6 fatty acid

Declarations

The authors declare that they have no conflict of interest.

Ethics approval and consent to participate

This study has been approved by Local ethics review boards at shahid beheshti University of Medical Sciences (Ir. sbmu. retech.1397.1137).

Consent for publication

Institutional consent forms were used in this study.

Availability of data and material

Not applicable

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

MGh, SR, FB, AMJ, SAT, HSH, NA and KE designed the study, and were involved in the data collection, analysis, and drafting of the manuscript. NK, ZT and SD were involved in the design of the study, analysis of the data, and critically reviewed the manuscript. All authors read and approved the final manuscript.

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Tables

Table1: Main characteristics autistic and healthy children

	Cases (n=100)	Controls (n=100)	P
Age (y)	12.49(±2.17)	12.94(±1.02)	0.29
Males (n)	70 (70%)	63 (63%)	0.13
Weight (kg)	63.39(±14.207)	62.05(±16.987)	0.10
Height (m)	1.63(±14.191)	1.65(±13.927)	0.93
BMI (kg/m ²)	18.16(±4.22)	22.22(±4.56)	0.57
Birth weight	2938(±467.03)	2750(±548.49)	0.01
Mothers' age (y)	25.7 (4.57)	35.5 (7.54)	0.06
Mothers' BMI	27.44(±12.5)	24.5(±15.3)	0.01
Mothers' smoking	1 (1%)	0 (0)	0.49

BMI: body mass index

Table2: Calorie, protein, carbohydrate and total fat intake between two groups.

	Cases (n=100)	Controls (n=100)	OR(CI95%)*	P
Energy(kcal)	3071 (±1055.37)	2402 (±850.35)	1.02 (0.98-1.05)	0.63
Protein(g/day)	101(±44.52)	100(±39.49)	1.04 (0.91-1.2)	0.45
Carbohydrate(g/day)	401(±140.62)	284(±103.44)	0.91(0.78-1.03)	0.47
Total fat(g/day)	126 (±52.67)	99 (±48.99)	0.87(0.81-0.97)	0.64

*Adjusted for age, sex, BMI, birth weight, mothers' age, mothers' BMI, mothers' smoking, and calorie and macronutrients intake

Table3: Comparison of mean fatty acid intakes in children with autism spectrum disorder (ASD) and healthy children

	Cases (n=100)	Controls (n=100)	OR(CI95%)*	P
SFA(g/day)	39.37(±36.54)	28.28(±16.09)	1.67(0.98-1.20)	0.75
MUFA(g/day)	46.11(±17.78)	37.19(±19.65)	3.18(1.13-4.56)	0.04
PUFA(g/day)	31.20(±13.63)	24.87(±15.27)	4.12(2.01-6.25)	0.01
LA (g/day)	27.26(±11.26)	22.18(±14.47)	4.76(1.34-14.32)	0.01
ALA (g/day)	1.35(±1.06)	1.02(±1.35)	0.38 (0.09-1.54)	0.08
EPA(g/day)	0.03(±0.038)	0.02(±0.140)	0.71(0.2-1.53)	0.54
DHA (g/day)	0.26(±0.806)	0.74(±0.422)	0.611(0.01-1.45)	0.96
Trans fatty acid (g/day)	0.01(±0.01)	0.01(±0.01)	1.18(0.65-1.78)	0.68

*Adjusted for age, sex, BMI, birth weight, mothers' age, mothers' BMI, mothers' smoking, and calorie and macronutrients intake

SFA: saturated fatty acids; MUFA: monounsaturated fatty acids; PUFA: polyunsaturated fatty acids; LA: Linoleic acid; ALA: α-Linolenic acid; EPA: eicosapentaenoic acid; DHA: docosahexaenoic acid