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The Correlation of Fatty Acid Profile with Disease Severity and Body Mass Index in Children with Atopic Dermatitis

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Abstract

Background: Atopic dermatitis is a chronic inflammatory skin disease that affects 20% of children. Fatty acids are a vital dietary component in the protection and maintenance of health.

Objectives: The aim of this study was to investigate the correlation of fatty acid profile involving myristic acid, palmitic acid and stearic acid from saturated fatty acids and palmitoleic acid, oleic acid, linoleic acid, linolenic acid and arachidonic acid from unsaturated fatty acids with disease severity and BMI in children with atopic dermatitis.

Methods: A total of 36 patients with atopic dermatitis and 40 healthy controls between the ages of 5-15 years were included in the study. The demographic characteristics and BMI of the participants were recorded. The SCORAD index of the patient group was calculated. Eosinophil percentage and IgE level were determined in autoanalysers. Agilent brand 7890/5970C model Gas chromatography-mass spectrometry (GC-MS) was used for fatty acid analysis.

Results: The groups were similar in terms of age, gender and BMI. Essential fatty acids and unsaturated fatty acids were significantly lower in the atopic dermatitis group. A negative correlation was found between essential and unsaturated fatty acids and disease severity, BMI, Ig E, and eosinophil percentage.

Conclusions: In this study, it was concluded that fatty acids are correlated with disease severity, allergic inflammatory parameters and BMI in patients with atopic dermatitis. We think that this condition may be related to less intake of essential and unsaturated fatty acids to the body, or increased consumption of these fatty acids in inflammatory processes triggered by increased fat tissue and disease.

Keywords: Atopic dermatitis, children, fatty acids, BMI, IgE, eosinophil percentage.

Introduction

Atopic dermatitis (AD) is a chronic, pruritic, inflammatory skin disease that affects 20% of children (1). Overactive immune response and impaired skin barrier are thought to cause the disease (2). Bioactive lipids are important for cutaneous inflammatory processes and the functioning of the immune system (3). The fatty acids in the skin are defined as one of the main components of the stratum corneum, the top layer of the epidermis, and are effective in maintaining the epidermal barrier integrity by creating an acidic environment on the surface of the stratum corneum (4). Defective fatty acid metabolism may cause deterioration in the lipid composition of the stratum corneum and improper interaction with other epidermal components, leading to deterioration of the epidermal barrier. On the other hand, the deterioration of the balance between the fatty acids which are the precursors of the lipid mediators that regulate the inflammation is thought to contribute to the inflammation in atopic dermatitis (5).

Childhood obesity affects the immune system by altering the serum levels of inflammatory and anti-inflammatory cytokines and proteins. Therefore, obesity has been reported to cause or exacerbate diseases such as asthma, allergy and AD (6).The aim of this study was to investigate the correlation of fatty acid profile with disease severity and body mass index (BMI) in children with atopic dermatitis.

Materials and Methods

The study has been approved by the local ethics committee. The parents of the participants included in the study were informed about the study and their written informed consents were obtained. The study included 36 patients between the ages of 5 and 15 years diagnosed with atopic dermatitis and 40 healthy controls in the same age range with no known systemic or dermatological disease. The demographic characteristics of the participants were recorded. BMI was calculated from height and weight values and interpreted in respect to the percentile chart prepared based on age and gender. Those with persentile values below 5% were considered as slim, 5% to 85% as normal, 85% to 95% as overweight, and over 95% as obese (7).

Patient selection, inclusion and exclusion criteria

The diagnosis of atopic eczema was established in patients with pruritic, chronic or recurrent dermatitis in disease-specific distribution regions meeting three of the Hanifin and Rajka main criteria (8).The patients presented to the clinic with active complaints were included in the study. The patients were evaluated clinically and their Severity Scoring of Atopic Dermatitis Index (SCORAD) were calculated. Those with a SCORAD index below 20 were considered as mild, between 20-40 as moderate, and over 40 as severe eczema (9). Slim, overweight or obese subjects were not included in the control group. Those with known endocrine or metabolic disease, those who are on diet to lose weight, those who use lipid-lowering drugs, supplements containing fish oil and retinoic acid-derived drugs were not included in the study.

Sample collection and processing

The patients were not given a special diet program prior to the study. The venous blood samples of the participants were taken in the morning after at least eight hours fasting. The eosinophil percentage and IgE level obtained from whole blood count were studied in autoanalysers. The serum samples obtained by

centrifugation of blood samples at 1800 rpm for 30 minutes were stored at -80°C until the day of analysis. 200 µL was taken from the serum samples that came back to the room temperature on the day of analysis. Agilent brand 7890/5970C model Gas chromatography-mass spectrometry (GC-MS) was used for fatty acid analysis. The protein content was settled by adding 1 milliliter of 5% H_2SO_4 to the serum sample. The fatty acids were extracted by vortexing with 3 milliliters of ethyl acetate for 60 seconds. It was then centrifuged at 4000 rpm for 10 minutes. The ethyl acetate phase was evaporated under N_2 (nitrogen).After adding 2 mL of 10% H_2SO_4-CH_3OH to the residue, it was incubated at 62°C for 2 hours. 2 mL of saturated NaCl and 2 mL of hexane were added sequentially. It was vortexed for 60 seconds to obtain fatty acid methyl esters. The organic phase was evaporated under N_2 gas and analyzed by adding 100 µL of hexane.

Chromatographic conditions of analysis

The chromatographic conditions of the device are as follows: Starting from 120°C to 270°C, a total of 55 minutes of ramp temperature program was applied. Optima brand 60 m x 0.25 mm column was used. Injection volume is µL, solvent delay time is 15 minutes, FID detector is 280°C, hydrogen gas flow is 35 mL/min, dry air gas flow is 350 mL/min, nitrogen is 20.2 mL/min. The split ratio is 10:1. The results were confirmed by studying all samples twice.

Statistical analysis

SPSS v.16.0 package program was used for statistical evaluation of obtained data in study (SPSS Inc, Chicago, Illinois, USA). The continuous data were given as mean, standard deviation, and the categorical data were given in numbers and percentages. The chi-square test was used to evaluate the correlation between two categorical variables, and the pearson correlation test were used to evaluate the correlation between two continuous variables. The independent T test was used to compare continuous variables between the groups. P values below 0.05 were considered to be statistically significant.

Results

The study included 36 children with atopic dermatitis presenting with active complaints and 40 healthy controls. The characteristics of the participants according to the groups are given in Table 1. Fatty acids were evaluated between the groups according to their saturated, unsaturated and essential status. Plasma free fatty acid proportions in children with atopic dermatitis and control cases are given in Table 2. When the cases were evaluated according to SCORAD index, the disease severity was mild in 19 cases (52.8%), moderate in 11 cases (30.6%) and severe in 6 cases (16.6%). According to BMI, the whole control group (100%) consisted of normal weight individuals. Whereas, of the patient group, 8.3% (n=3) were slim, 69.4% (n=25) were normal, 16.7% (n=6) were overweight, and 5.6% (n=2) were obese. There was a positive correlation between BMI with SCORAD index, IgE, and eosinophil percentage (r and p values respectively, 0.339, 0.003; 0.317, 0.005; 0.186, 0.108) in patient group. The relationship between fatty acids with BMI and SCORAD indexis given in Table 3, and the correlation between essential, saturated, and unsaturated fatty acids with BMI, SCORAD index, IgE and eosinophil percentage is given in Table 4.

Table 1: Characteristics of participants by group

	Atopic dermatitis group (n=36)	Control group (n=40)	p
Gender (female/male)	16/20	19/21	0.790*
Age (years)	7.92±3	8.5±2.7	0.376**
BMI percentile	57.1±25.3	54.3±13.9	0.550**
Ig E (IU/ml)	261.9±619.4	51.0±25.1	0.035**
% Eosinophil	3.3±3.4	1.9±2.0	0.021**
*Chi-square test was performed. ** Student t test was used to compare continuous variables in independent groups.			

Table 2: Plasma free fatty acid proportions in children with atopic dermatitis and control cases

Fatty acid	Atopic dermatitis group (%)	Control group(%)	95% Confidence interval		p*
			Lower	Upper	
Arachidonic acid (C20: 0)	5.03±6.64	8.16±8.41	4.91	8.45	0.079
Linolenic acid (C18: 3)	1.74±2.12	2.75±2.87	1.68	2.86	0.089
Linoleic acid (C18: 2)	19.64±8.21	22.43±8.92	19.13	23.08	0.160
Oleic acid (C18: 1)	21.59±5.29	25.41±10.69	21.61	25.59	0.056
Myristic Acid (C14: 0)	0.33±0.72	0.25±0.67	0.13	0.44	0.623
Steraic acid (C18: 0)	22.37±9.78	19.87±5.53	19.25	22.85	0.168
Palmitoleic acid (C16: 1)	0.65±0.74	0.86±0.93	0.57	0.95	0.261
Palmitic acid (C16: 0)	29.13±9.21	26.87±9.39	25.81	30.07	0.293
Essential fatty acids	26.41±11.39	33.33±15.02	26.90	33.20	0.026
Saturated fatty acids	51.83±13.24	46.98±11.55	46.42	52.14	0.095
Unsaturated fatty acids	48.65±12.49	59.60±15.65	50.94	54.05	0.001
* Student t test was used to compare continuous variables in independent groups.					

Table 3: The relationship between fatty acids with BMI and SCORAD index

	Arachidonic acid	Linolenic acid	Linoleic acid	Oleic acid	Myristic Acid	Steraic acid	Palmitoleic acid	Palmitic acid
BMIpercentile	r=0.048 p=0.683	r=-0.257 p=0.025	r=-0.073 p=0.530	r=-0.073 p=0.533	r=-0.115 p=0.324	r=0.083 p=0.477	r=0.310 p=0.006	r=-0.041 p=0.724
SCORAD index	r=-0.194 p=0.094	r=-0.205 p=0.075	r=-0.091 p=0.437	r=-0.173 p=0.134	r=-0.038 p=0.745	r=0.039 p=0.739	r=-0.114 p=0.326	r=0.156 p=0.178
Pearson correlation test was used to evaluate the relationship between two continuous variables.								

Table 4: The correlation between essential, saturated and unsaturated fatty acids and BMI, SCORAD index, IgE, and eosinophil percentage

	Essential fatty acids	Saturated fatty acids	Unsaturated fatty acids
BMI percentile	r=-0.067 p=0.564	r=0.015 p=0.897	r=-0.085 p=0.463
SCORAD index	r=-0.204 p=0.077	r=0.139 p=0.232	r=-0.291 p=0.011
IgE (IU/ml)	r=-0.043 p=0.713	r=0.095 p=0.414	r=-0.021 p=0.860
% Eosinophil	r=-0.196 p=0.090	r=-0.154 p=0.184	r=-0.280 p=0.014
Pearson correlation test was used to evaluate the relationship between two continuous variables.			

Discussion

The effect of diet on the disease is of interest in atopic dermatitis, a chronic inflammatory skin disease caused by the complex interaction of genetic, physiological and environmental factors (10). Physical, chemical and nutritional properties of fatty acids are determined by the number of carbon atoms in the molecule, level of saturation, number of double bonds between carbon atoms, and position of the hydrogens bound to carbon atoms. Fatty acids are divided into two, saturated and unsaturated, according to the number of bonds between carbon atoms. There is no double bond in saturated fatty acid chains. Palmitic, stearic and myristic acids, which are the fatty acids evaluated in this study, are saturated fatty acids (11). Although calories taken with saturated fatty acids are the same with calories given by other fatty acids, they cause fat accumulation and weight gain in the body (12). In this study, there was a positive correlation between saturated fatty acids and BMI in accordance with the literature. In a study investigating fatty acid profile in children with and without abdominal obesity, the levels of palmitoleic acid and γ-linoleic acid were significantly higher in obese children (13). In this study, there was a significant positive correlation between palmitoleic and linolenic acid and BMI.

Despite the increasing evidence regarding a relationship between obesity and atopic diseases, the underlying mechanisms are still not fully known. It is suggested that the prevalence of these diseases increases as a result of decreasing immunological tolerance in relation to a number of changes in the immune system caused by adipokines secreted by adipose tissue, cytokines and tumor necrosis factor alpha (10). In a study investigating the correlation between obesity and atopic dermatitis, it was reported that atopic dermatitis was more common in overweight and obese children (14). In a conducted study, it was reported that increased BMI was correlated with disease severity in children older than 2 years (15). In this study, BMI was positively correlated with disease severity and allergic inflammatory parameters, IgE and eosinophil percentage.

Unsaturated fatty acids contain one or more double bonds on the chain. Linoleic acid, linolenic acid, arachidonic acid, palmitoleic acid and oleic acid are unsaturated fatty acids. Fatty acids containing one double bond in their structure are called monounsaturated fatty acids, fatty acids containing more than one double bond are called polyunsaturated fatty acids. Arachidonic acid, linoleic acid and linolenic acid, some of the polyunsaturated fatty acids, have important effects on biochemical and physiological changes in the body and are essential fatty acids (11). Arachidonic acid is the precursor of eicosanoids consisting of prostaglandin, leukotriene and thromboxanes. In one study, it was reported that polyunsaturated fatty acids would promote the development of allergic diseases by intensifying IgE production through eicosanoid formation of polyunsaturated

fatty acids (10). In inflammatory processes, including allergic inflammation, the production of prostaglandin and leukotriene in mast cells and macrophages results in deprivation of long chain fatty acids (16). In a study conducted in allergic patients, arachidonic acid levels were not changed, but arachidonic acid precursors palmitic and oleic acid levels were significantly higher in patients (17).In this study, similar to literature, arachidonic acid levels did not differ significantly. In addition, essential fatty acids were significantly lower in the atopic dermatitis group and there was a negative correlation with disease severity.

Unsaturated fatty acids, beginning from the methyl group of the fatty acid molecule, are divided into 3 groups as omega 3, 6 and 9, depending on the status of carbon atom in which the first double bond is present (11). Linoleic acid from omega-6 family and α-linolenic acid from omega-3 family are two main unsaturated fatty acids and precursors of long-chain fatty acids containing γ-linolenic acid, arachidonic acid, docosahexaenoic acid, and eicosapentaenoic acid (18). In a study by Fujii et al. conducted on mice, atopic dermatitis-like itchy skin inflammation was modeled by a special diet. It was observed that lesions regressed with unsaturated fatty acid supplementation, and that the dietary deficiency of linoleic acid was the cause of dermatitis (19). Linoleic acid and α-linolenic acid play a part in the protection of the epidermal barrier, maturation and differentiation of the stratum corneum (18). In this study, the levels of linolenic acid and linoleic acid were lower in the atopic dermatitis group but did not make a statistically significant difference.

It is believed that there is a correlation between increased intake of omega-6 polyunsaturated fatty acids and increased allergic diseases. This has been associated with the increase of eicosanoid mediators produced from arachidonic acid. Omega-3 fatty acids reduce the eicosanoid synthesis. Omega-3 series fatty acids have been reported to be protective against allergic sensitivity or allergic symptoms (18). In comparison with omega-3, high amounts of omega-6 polyunsaturated fatty acid consumption has been associated with the increased prevalence of atopic diseases (10). In one study, it has been shown that the fatty acid status of the fetus during pregnancy plays an important role in the development of atopic eczema in early childhood. This has been associated with low blood and blood plasma levels of omega-3 series fatty acids (20). On the other hand, in a review of the relationship between breast milk fatty acids and allergic diseases, it was concluded that PUFA did not affect the risk of allergic disease in children (21). The role of unsaturated fatty acids in inflammation has been demonstrated in an experimental model of respiratory allergy in mice, where an inflammatory reaction induced by allergen threat was accompanied by a rapid decrease in the serum levels of both omega-3 and omega-6 long-chain PUFAs (22). In this study, there was a negative correlation between unsaturated fatty acids with disease severity and IgE. In a study conducted by Miyata et al. in patients with rhinosinusitis, inflammatory tissue-derived eosinophils have been shown to be a specific phenotype with irregular fatty acid metabolism (23). In this study, the eosinophil percentage was significantly higher in the atopic dermatitis group and there was a negative correlation between the unsaturated fatty acids and the eosinophil percentage.

In this study, it was concluded that fatty acids, important component of diet, are correlated with disease severity, allergic inflammatory parameters and BMI in patients with atopic dermatitis. A negative correlation was found between essential and unsaturated fatty acids and disease severity, BMI, IgE and eosinophil percentage. We believe that this may be related to the reduced intake of essential and unsaturated fatty acids to the body or its increased consumption during inflammatory processes.

Limitations of the study

Not giving a special diet before the study, not questioning the content of the patients' foods they ate, not analyzing the alpha and gamma fractions of linolenic acid are the limitations of the study.

Ethics committee approval: Kahramanmaraş Sütçü İmam University ethics committee approvaled the study (Date: 24.10.2018; Decision number:19; Session: 2018/10).

İnformed consent: The participants were given their informed consent before taking part in study.

Conflict of interest: There is no conflict of interest.

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References

1. Flohr C, Mann J. New insights into the epidemiology of childhood atopic dermatitis. Allergy 2014; 69:3-16.
2. Brunner PM, Israel A, Zhang N, Leonard A, Wen HC, Huynh T, et al. Early-onset pediatric atopic dermatitis is characterized by T(H)2/T(H)17/T(H)22-centered inflammation and lipid alterations. J Allergy Clin Immunol. 2018; 141(6):2094-2106.
3. Kendall AC, Nicolaou A. Bioactive lipid mediators in skin inflammation and immunity. Prog Lipid Res. 2013; 52(1):141-64.
4. Li S, Ganguli-Indra G, Indra AK. Lipidomic analysis of epidermal lipids: a tool to predict progression of inflammatory skin disease in humans. Expert Rev Proteomics. 2016; 13(5):451-6.
5. Venter C, Meyer RW, Nwaru BI, Roduit C, Untersmayr E, Adel-Patient K, et al. EAACI position paper: Influence of dietary fatty acids on asthma, food allergy, and atopic dermatitis. Allergy. 2019; 29. doi: 10.1111/all.13764.
6. Kelishadi R, Roufarshbaf M, Soheili S, Payghambarzadeh F, Masjedi M. Association of Childhood Obesity and the Immune System: A Systematic Review of Reviews. Child Obes. 2017; 13(4):332-346.
7. Obezite, T.E.M.D., Lipid Metabolizması, Hipertansiyon Çalışma Grubu. " Obezite tanı ve tedavi kılavuzu." Türkiye Endokrinoloji ve Metabolizma Derneği 2017; 11-33.
8. Hanifin J, Rajka G. Diagnostic features of atopic dermatitis. Acta Derm Venereol 1980; 92:44-7.
9. Severity scoring of atopic dermatitis: the SCORAD index. Consensus Report of the European Task Force on Atopic Dermatitis. Dermatology. 1993; 186: 23-31.
10. Suárez-Varela MM, Alvarez LG, Kogan MD, Ferreira JC, Martínez Gimeno A, Aguinaga Ontoso I, et al. Diet and prevalence of atopic eczema in 6 to 7-year-old schoolchildren in Spain: ISAAC phase III. J Investig Allergol Clin Immunol. 2010; 20(6):469-75.
11. Çakmakçı S, Kahyaoğlu DT. Effects of Fatty Acids on Health and Nutrition. Turkish Journal of Scientific Compilations. 2012;5(2):133-137.
12. Hannon BA, Thompson SV, An R, Teran-Garcia M. Clinical Outcomes of Dietary Replacement of Saturated Fatty Acids with Unsaturated Fat Sources in Adults with Overweight and Obesity: A Systematic Review and Meta-Analysis of Randomized Control Trials. Ann Nutr Metab. 2017;71(1-2):107-117.
13. Aristizabal JC, González-Zapata LI, Estrada-Restrepo A, Monsalve-Alvarez J, Restrepo-Mesa SL, Gaitán D. Concentrations of Plasma Free Palmitoleic and Dihomo-Gamma Linoleic Fatty Acids Are Higher in Children with Abdominal Obesity. Nutrients. 2018; 10(1). pii: E31.
14. Zhang A, Silverberg JI. Association of atopic dermatitis with being overweight and obese: a systematic review and metaanalysis. J Am Acad Dermatol. 2015; 72(4):606-16.e4.
15. Koutroulis I, Magnelli L, Gaughan J, Weiner E, Kratimenos P. Atopic dermatitis is more severe in children over the age of two who have an increased body mass index. Acta Paediatr. 2015; 104(7):713-7.
16. Barman M, Jonsson K, Sandin A, Wold AE, Sandberg AS. Serum fatty acid profile does not reflect seafood intake in adolescents with atopic eczema. Acta Paediatr. 2014; 103(9):968-76.
17. Obeso D, Mera-Berriatua L, Rodríguez-Coira J, Rosace D, Fernández P, Martín-Antoniano IA, et al. Multi-omics analysis points to altered platelet functions in severe food-associated respiratory allergy. Allergy. 2018; 73(11):2137-2149.

18. McCusker MM, Grant-Kels JM. Healing fats of the skin: the structural and immunologic roles of the omega-6 and omega-3 fatty acids. Clin Dermatol. 2010; 28(4):440-51.
19. Fujii M, Shimazaki Y, Muto Y, Kohno S, Ohya S, Nabe T. Dietary deficiencies of unsaturated fatty acids and starch cause atopic dermatitis-like pruritus in hairless mice. Exp Dermatol. 2015; 24(2):108-13.
20. Montes R, Chisaguano AM, Castellote AI, Morales E, Sunyer J, López-Sabater MC. Fatty-acid composition of maternal and umbilical cord plasma and early childhood atopic eczema in a Spanish cohort. Eur J Clin Nutr. 2013; 67(6):658-63.
21. Waidyatillake NT, Dharmage SC, Allen KJ, Lodge CJ, Simpson JA, Bowatte G, et al. Association of breast milk fatty acids with allergic disease outcomes-A systematic review. Allergy. 2018; 73(2):295-312.
22. Johansson S, Lonnqvist A, Ostman S, Sandberg AS, Wold AE. Long-chain polyunsaturated fatty acids are consumed during allergic inflammation and affect T helper type 1 (Th1)- and Th2-mediated hypersensitivity differently. Clin Exp Immunol. 2010; 160:411–9.
23. Miyata J, Fukunaga K, Kawashima Y, Watanabe T, Saitoh A, Hirosaki T, et al. Dysregulated fatty acid metabolism in nasal polyp-derived eosinophils from patients with chronic rhinosinusitis. Allergy. 2019 Jan 22.

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