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Investigating the relationship between anthropometric profiles, dietary oxygen radical absorption capacity and healthy eating index with acne in adolescents

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Abstract

Objective Acne is one of the most common skin diseases, especially among teenagers. Many factors were blamed for creating acne including nutrition. The purpose of this study was to evaluate the relationship between body mass index, oxygen radical absorption capacity (ORAC), and healthy eating index (HEI), and acne among adolescents. This case-control study was conducted on 57 students with acne and 57 students without acne. Demographic information, food frequency and anthropometric indices were collected. The amount of ORAC was determined by USDA data. The HEI was calculated using HEI-2015 for 9 components. The data were analyzed using SPSS software.

Results In this study cross-sectional study, the average weight in the group with and without acne was 62.27 ± 11.50 vs. 59.26 ± 14.33, and there was no significant difference between weight and acne ($P = 0.219$). Chromium intake in people without acne was significantly higher ($P < 0.022$). The macronutrient and micronutrient intakes were insignificantly higher in the healthy group. Food group intake was not significantly different between the healthy and sick groups. There was no significant difference in the ORAC ($P = 0.814$), and the HEI between the two groups with acne and healthy people ($P = 0.616$). No correlation was found between HEI, and ORAC with acne as well. The findings of this study showed that anthropometric indices, HEI and ORAC had no significant relationship with acne. To have tangible conclusion, further large-scale cohort study is highly recommended.

Keywords Oxygen radical absorption capacity (ORAC), Healthy eating index (HEI), Anthropometric indices, Acne, Nutrients

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Introduction

Acne vulgaris is one of the most common skin diseases, especially among teenagers. It is related to excess production of skin sebaceous glands, inflammation inside and adjacent to comedones, and excessive increases in *Propionibacterium* [1]. Although acne occurs more frequently during adolescence and puberty by increasing the release of sex hormones, 85% of people might face acne at least once in their lives. According to previous studies, the peak age of acne is 17 years old [2]. In Iran, acne was also more common among females than males [3], and approximately 60%, 31.5%, and 8.5% of teenagers had mild, moderate, and severe acne, respectively [4].

In spite of the fact that youth is the particular bunch, skin break out may influence different age groups [5, 6]. The term "juvenile acne" is defined for 10–19 year olds. However, the term is somewhat misused for patients aged 19–24. According to the World Health Organization, the term "adolescent" includes ages 10 to 24, so the authors suggest that patients who developed acne between the ages of 10 and 24 should be called "juvenile acne," while patients, who developed acne between the ages of 10 and 24 years should be called "youth acne". Previous studies have reported that up to 9.3% of acne occurs after the age of 25 [7]. Acne over the age of 25 is called adolescent or adult acne [6]. Similarly, the authors believe that the term "adult acne" may be more appropriate than "postadolescent" because post puberty refers to individuals over the age of 19. Adult acne is divided into three groups. If it starts in adolescence and continues, it is called "persistent acne", while if it first appears after the age of 25, it is called "late acne". Finally, "relapsing acne" is used to refer to acne that resolves and persists in attacks from adolescence to adulthood [8, 9]. However, many studies have separated acne into two categories, including persistent acne and late acne. Persistent acne has been reported as the most common type of acne in adults, accounting for 73.2–82% of cases [6, 10]. Acne is most likely to develop during puberty due to increased hormone levels in both sexes. At the onset of puberty, gonadotropin-releasing hormone (GnRH) is released, which causes two additional hormones, luteinizing hormone (LH) and follicle-stimulating hormone (FSH), to be released into the bloodstream from the pituitary gland in both boys and girls [11].

In boys, these hormones trigger the production of testosterone, and in girls, the production of estrogen. This increase in hormones also increases the production of sebum (the oily secretion of the sebaceous glands), which accelerates the development of acne [12–14].

Various internal and external factors, such as air pollution, unsanitary skin care products, some of drugs, physical factors, hormones, ethnicity, lifestyle, and stress, have been proposed to affect acne. Healthy eating has been shown to be related to many diseases, including skin disorders [15]. For many years, it was believed that nutrition causes or exacerbates acne [16]. Despite this belief, the relationship between diet and acne is always controversial. Convincing evidence suggests that diets with a high glycemic index may exacerbate acne [17]. Eating dairy products seems to be weakly associated with acne, and the role of omega-3 fatty acids, dietary fiber, antioxidants, vitamin A, zinc, and iodine is still unclear. The effect of diet on the severity of acne vulgaris still needs much research, but it should no longer be stated as superficial evidence that there is no relationship between diet and acne [18, 19]. These findings were based on population studies that showed that Western diets are related to acne [17]. Several studies have shown that inflammatory markers are related to an increase in the omega-6/omega-3 ratio. It seems that omega-6 fatty acids lead to more anti-inflammatory mediators and are related to the development of inflammatory acne [18]. On the other hand, consuming high levels of omega-3 fatty acids is associated with a reduction in inflammatory factors. In addition, epidemiological studies show that increasing the consumption of omega-3 fatty acids through a diet rich in fish and seafood reduces the rate of inflammatory diseases. Additionally, some of studies has shown that fat or carbohydrate consumption not only could increase the sebum production but also affect the composition of sebum. In general, the Western diet is not only deprived of omega-3 but also a diet containing refined carbohydrates [18, 20]. In recent years, research has been performed on a single food item, including dark chocolate, milk and the fat content of foods with acne [1]. However, in these studies, the simultaneous effect of all foods by using HEI on acne and the possible synergistic effect of foods on each other have not been studied, so there is a need for research that examines the effect of all foods simultaneously on the severity of acne. Moreover, the oxygen radical absorption capacity (ORAC) which was calculated by USDA values from people's diet, as a method of measuring antioxidant capacity in biological samples in the laboratory [21–23] has not been checked in people with acne yet. Therefore, in the present study, due to lack of the parts of this jigsaw puzzle, the relationship between both HEI and ORAC along with anthropometric indices with acne was investigated.

Materials and work methods

This case-control study was conducted using a simple random method in schools covered by Shahryar city on 57 students with acne and 57 students without acne aged 12–18 years old. Gpower 3.9.1.7 software was used to calculate the sample size based on linear bivariate regression for two groups, difference between intercepts with alpha error 0.05 and power 80 [24] and following previous

similar studies in this era [25–27]. The inclusion criteria included adolescent boys and girls aged 12–18 who had acne and were willing to cooperate with the project, and due to the effect of some of diseases and medicines on acne, the exclusion criteria included having a history of chronic kidney and liver diseases, blood disorders, microalbuminuria, hypo- or hyperthyroidism, and using contraceptive pills and corticosteroids. All the volunteers were informed about the project and signed the consent form before entering the study. All the methods and procedures of the present study have been approved by the Research Ethics Committee of the Faculty of Medical Sciences of the University of Sciences and Research based on the Helsinki declaration with the code of ethics under the approved number IR.IAU.TMU.REC.1399.175 of the Islamic Azad University of Science and Research Branch. Consent form was also has been approved the council as well.

Studied volunteers

First, the subject of the study, the objectives of the research, and the method of its implementation were fully explained to all the eligible people by the authors, and then they were asked to sign a written consent form if they were willing to cooperate. For under 16 years old, all the procedures of the study were fully informed to their parents and consent form was signed by them. On the day of going to school, with clinical examination and confirmation of acne diagnosis, students with acne were included in the case group, and students without acne were included in the control group. In order to collect control group, history of acne was asked from all the volunteers, and who has not previous history of acne was collected to control group. Volunteers who already have acne was referred to skin disorder specialist for acne confirmation. From the volunteer students, information related to the basic characteristics of the people, including age, sex, history of diseases, type and number of medications, level of education and family income, was obtained through face-to-face interviews and questionnaire completion. On the same day, anthropometric indicators, including height and weight, waist circumference (WC), hip circumference (HC), waist-to-hip ratio (WHR), body muscle percentage, body fat percentage (BFP), and basal metabolic rate (BMR), were measured using the Omron BF-511 body composition analyzer with an accuracy of 0.1 kg, evaluated according to standard protocols, and body mass index was calculated [28]. WHO Anthro plus (Version 1.0.4) was used to calculate BMI for age (BAZ) and height for age (HAZ) Z-scores.

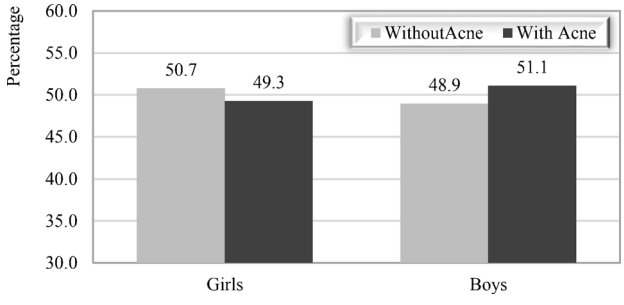

Fig. 1 Comparison of the frequency between genders for acne disease

Food intake analysis

Food intake was measured with a valid and reliable 147-item food frequency questionnaire (FFQ) through face-to-face interviews [29]. The interviews were conducted by trained nutritionists. The size of standard units and those reported based on home-scales were converted to grams using the Iranian guide for home scales [30]. The Kennedy's et al. method was used to calculate HEI [31] which has been validated in many studies in Iran [32, 33]. HEI calculation was based on ten different components. The first five components counting the quantity of five groups including grains, fruits, vegetables, meat and milk. The sixth, seventh and eighth components are scored according to the percentage of total fat, SFA and cholesterol intakes. For each component, a maximum score (i.e. 10 points) is given to the diet with < 30% of energy from total fat, < 10% energy from SFA and < 300 mg cholesterol. The ninth component concerns dietary variety and the last concerns sodium intake.

To evaluate the absorption capacity of dietary oxygen radicals, the amount (ORAC) calculated for 326 different foods listed in the USDA database was used [22]. In this database ORAC values are reported for lipophilic-ORAC (LORAC), hydrophilic-ORAC (H-ORAC), Total-ORAC, and total phenolics (TP). L-ORAC, H-ORAC, and total-ORAC are reported in μmol of Trolox equivalents per 100 g (μmolTE/100 g), while TP is reported in mg gallic acid equivalents per 100 g (mgGAE/100 g) [22].

Statistical analysis

The Shapiro-Wilk test was used to check the normality of the data distribution [34]. The t test was used to compare the mean of quantitative variables between the two studied groups and the Pearson correlation test was used to find out the relationship between the food intake and acne. SPSS software version 25 was used for data analysis, and a P value < 0.05 was considered statistically significant.

Results

This case-control study was conducted using a simple random method in schools covered by Shahryar city on 57 students with acne and 57 students without acne aged 12–18. As Fig. 1 shows there was no significant difference between acne disease among boys and girls in this

present study. As Table 1 shows, the average weight in the group with acne was 3.1 kg higher than that without acne, and no significant difference between weight and acne was observed ($P=0.219$). Additionally, there was no significant difference in height, BMI, BFP, or muscle percentage between the two groups. Regarding other anthropometric factors, such as WC, HC, WHR, and BMR, no statistically significant difference was observed between the two groups with acne and without acne. No significant difference was observed between the z scores of BMI for age (BAZ) and height for age (HAZ) in the two groups either.

Table 2 examines the status of ORAC and HEI among the participants in the study. There was no significant difference in the ORAC between the healthy and sick groups ($P=0.814$), and the HEI did not show any significant difference between the studied groups ($P=0.616$).

As Fig. 2 illustrates, despite lower frequency of acne among people with high HEI no significant difference was observed between groups in both genders.

Table 3 illustrates the daily food group intake. Food groups, including grains and starchy substances, legumes, meats, fast food, offal, dairy products, vegetables, seasonings, fruits, dried fruits, oils, sugary substances, tea and coffee, salt, snacks, and spices, were not significantly different between the healthy and sick groups.

Table 4 shows the relationship between anthropometric profiles, ORAC and HEI with acne. As it shows no significant relationship was observed.

As Table 5 shows, even after cofounder adjustment including gender, age, BMI and energy intake, no relationship was observed between HEI and ORAC with acne.

Table 1 Comparison of the mean and standard deviation of age and anthropometric profiles in people without acne and those with acne

Variable	Without acne (Mean ± SD)	With Acne (Mean ± SD)	*P**
Age (year)	15.40 ± 1.86	15.57 ± 1.83	0.611
Weight	59.26 ± 14.33	62.27 ± 11.50	0.219
Height	163.85 ± 8.50	165.16 ± 7.36	0.382
BMI	21.96 ± 4.21	22.81 ± 3.78	0.257
Fat Percentage	22.48 ± 9.44	25.55 ± 9.74	0.091
Muscle Percentage	35.28 ± 6.05	33.17 ± 7.17	0.093
Basal Metabolism	1472.91 ± 188.54	1492.05 ± 192.68	0.593
Hip Circumference	73.44 ± 8.34	75.25 ± 8.82	0.264
Waist Circumference	93.95 ± 8.76	96.00 ± 7.71	0.187
Waist Circumference/Hip Circumference	0.78 ± 0.05	0.78 ± 0.05	0.905
BMI for Age Z Score	0.39 ± 1.30	0.65 ± 1.22	0.286
Height for Age Z Score	-0.04 ± 1.37	-0.02 ± 1.51	0.954

* Based on independent sample t Test., SD; Standard Deviation

Table 2 Comparison of mean and standard deviation of healthy eating index and ORAC in two groups with acne and without acne

Micro/Macro nutrient	Without acne (Mean ± SD)	With Acne (Mean ± SD)	*P**
ORAC	2340493.14 ± 1139314.15	2288822.10 ± 1194790.41	0.814
HEI	52.42 ± 8.13	53.17 ± 7.83	0.616

* Based on independent sample t Test, SD; Standard Deviation

Discussion

In the present study, no significant relationship between weight, height, BMI, body fat percentage, muscle percentage, WHR, WC, HC, BMR, BAZ, and HAZ with acne

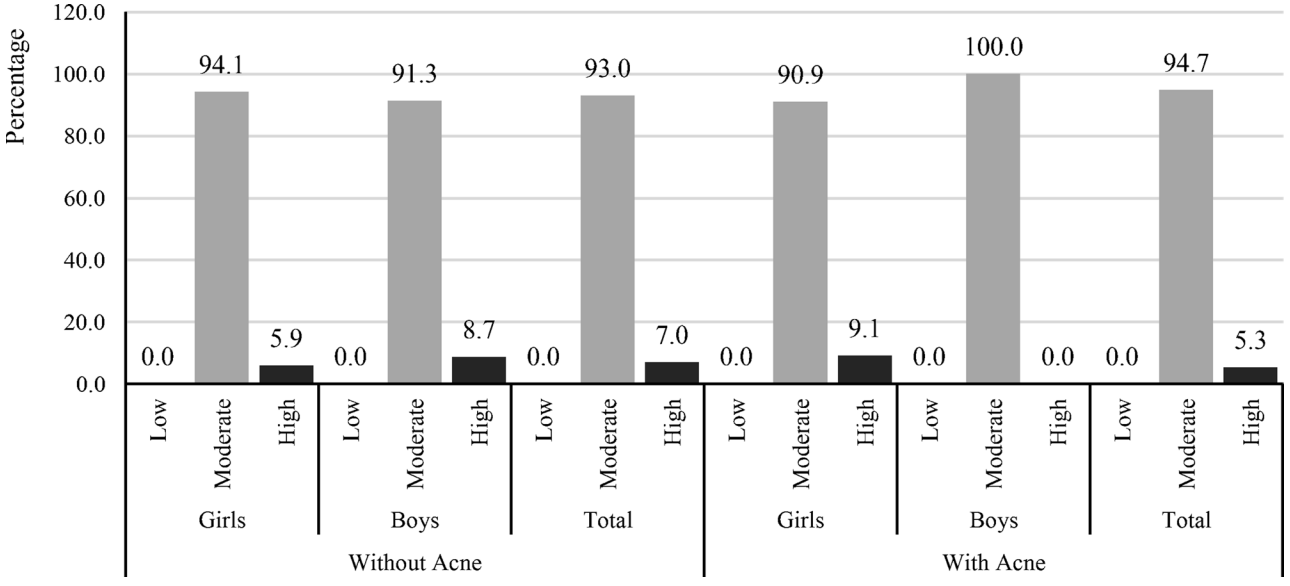

Fig. 2 Comparison of the Healthy Eating Index category among the non-acne control group and the people with acne group

Table 3 Comparison of the mean and standard deviation of the intake of different food groups between two groups with acne and without acne

Food groups	Without acne (Mean ± SD)	With Acne (Mean ± SD)	*P**
Cereals and starches	832.99 ± 346.41	765.04 ± 329.82	0.218
Beans	105.47 ± 83.60	117.62 ± 87.13	0.473
Meats	111.58 ± 101.60	99.02 ± 78.57	0.694
Fast food	33.70 ± 37.34	41.43 ± 55.04	0.704
Viscera	2.49 ± 4.60	3.27 ± 6.72	0.311
Dairy	512.71 ± 320.66	474.12 ± 378.00	0.268
Vegetable	333.14 ± 210.47	353.15 ± 353.39	0.340
Condiment	81.69 ± 97.27	81.78 ± 90.48	0.708
Fruits	462.09 ± 294.32	507.68 ± 479.04	0.762
Dried fruit	23.35 ± 39.77	19.57 ± 22.50	0.429
Oils	32.68 ± 26.52	34.61 ± 25.08	0.632
Sugary substances	90.33 ± 85.12	85.75 ± 91.93	0.648
Coffee and tea	281.13 ± 224.36	298.73 ± 261.57	0.672
Salt	3.57 ± 4.04	2.94 ± 3.28	0.328
Snacks	14.03 ± 13.19	13.68 ± 15.88	0.252
Spices	2.56 ± 3.01	2.28 ± 2.75	0.459

* Based on independent sample t Test., SD; Standard Deviation

was observed. In the study of Anaba and his colleagues in 2019 and the study of Sas and Reich in 2019, a significant relationship was observed between the body mass profile and acne [35, 36]. These two studies examined only one factor, which was BMI as an index of anthropometry, but in the present study, much more indices were measured. Moreover, there are two main differences between the present study and the previous one. First, they have tested on 1079 students which is a large scale for such a study, and the second, they have tested on Africans which might affect the results due to different ethnicity. The results of the present study are in line with the study of Snast and his colleagues in 2019, which was conducted in a large population of 600,404 teenagers. In that study, overweight and obesity were inversely related to the severity of acne [37]. Contradictory results have been obtained in other studies searched in this field. In a study carried out in Iran in 2016, Yazdanfar and his colleagues in Hamedan city found a significant relationship between BMI and acne in a comparison between women with acne and healthy women ($P = 0.001$), but statistically, no direct relationship between acne severity and BMI was found ($P = 0.384$) [38]. Their study also reached the same conclusion as the present study. According to the results, the assumption of a difference between the anthropometric indices in healthy individuals and acne patients was rejected, and there was no significant difference between the anthropometric indices between people with or without acne. Moreover, after adjusting the confounders of the study no relationship between examined variables was observed.

In the present study, although, as shown in Fig. 1, a higher HEI was observed among healthy people, no significant difference was observed between the HEI in the healthy and acne groups. In the study of Davallo and her colleagues in 2013, the relationship between the DDS and acne vulgaris was investigated, but no significant relationship was found between them [39]. In the present study, the relationship between the HEI and acne was not significant. Based on these studies, it seems that the relationship between the HEI and acne has been investigated in this study for the first time. Most of the studies have investigated food groups and single food items with acne; in some studies, this relationship was significant, and in others, it was not. For example, in the study of Aghasi and his colleagues in 2013, there was a significant difference

Table 4 The relationship between anthropometric profiles, ORAC and HEI with acne*

	CC*	*P**	B§	S.E. §	Sig. §	Exp(B) §	95% C.I.for EXP(B) §		Collinearity Statistic	
							Lower	Upper	Tolerance	VIF
ORAC	0.022	0.814	0.000	0.000	0.608	1.000	1.000	1.000	0.908	1.102
HEI	-0.047	0.616	0.027	0.026	0.300	1.027	0.976	1.082	0.770	1.298
Weight	-0.116	0.219	-0.254	0.164	0.122	0.776	0.562	1.070	0.008	117.678
Height	-0.083	0.382	0.345	0.199	0.084	1.412	0.955	2.088	0.008	133.269
BMI	-0.107	0.257	0.302	0.404	0.455	1.353	0.613	2.988	0.015	66.639
Waist	-0.159	0.091	0.813	0.445	0.068	2.255	0.942	5.399	0.001	987.606
HIP	0.158	0.093	-0.605	0.358	0.091	0.546	0.271	1.101	0.015	64.588
WHR	-0.051	0.593	-7.191	4.280	0.071	0.000	0.000	8.228	0.037	27.092
WhtR	-0.078	0.409	3.118	3.754	0.406	2.259	0.014	3.545	0.001	845.708
BMR	-0.106	0.264	0.001	0.003	0.684	1.001	0.995	1.007	0.124	8.072
Body Fat Percentage	-0.125	0.187	-0.034	0.072	0.641	0.967	0.840	1.114	0.082	12.220
Muscle percentage	0.011	0.905	-0.127	0.089	0.153	0.880	0.739	1.049	0.134	7.466
HAZ	-0.067	0.480	-1.014	0.973	0.298	0.363	0.054	2.444	0.038	26.346
BAZ	-0.119	0.207	1.185	0.784	0.131	3.272	0.703	15.222	0.051	19.779

* Using Pearson correlation Test. CC: Correlation Coefficient (R), P: *P*

§ Using Logistic regression Test

Table 5 The relationship between anthropometric profiles, ORAC and HEI with acne after adjusting cofounders*

Model		Coefficients [a]				
		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	0.063	0.434		0.146	0.884
	HEI	0.003	0.006	0.043	0.454	0.651
	ORAC	-5.71E-10	0	-0.001	-0.014	0.989
	BMI	0.013	0.012	0.105	1.085	0.28
2	(Constant)	-0.064	0.555		-0.115	0.909
	HEI	0.002	0.006	0.037	0.382	0.703
	ORAC	-6.37E-11	0	0	-0.002	0.999
	BMI	0.013	0.012	0.103	1.063	0.29
	Age	0.01	0.026	0.036	0.37	0.712
3	(Constant)	0.055	0.609		0.091	0.928
	HEI	0.001	0.006	0.02	0.199	0.843
	ORAC	2.82E-08	0	0.065	0.391	0.697
	BMI	0.013	0.012	0.104	1.066	0.289
	Age	0.009	0.027	0.031	0.322	0.748
	Energy intake	-2.98E-05	0	-0.082	-0.482	0.631
4	(Constant)	0.042	0.615		0.068	0.946
	HEI	0.001	0.007	0.021	0.204	0.839
	ORAC	2.67E-08	0	0.062	0.368	0.714
	BMI	0.013	0.012	0.102	1.037	0.302
	Age	0.008	0.027	0.03	0.304	0.761
	Energy intake	-3.15E-05	0	-0.086	-0.503	0.616
	Gender	0.023	0.103	0.023	0.227	0.821

in the consumption of dairy products, yellow vegetables, other vegetables, cereals, potatoes, whole grains, and refined grains with acne in two groups with acne and without acne [40]. However, in the present study, food groups including grains and starchy substances, legumes, meats, fast food, offal, dairy products, vegetables, seasonings, fruits, dry fruits, oils, sugary substances, tea and coffee, salt, snacks, and spices in the two healthy groups and patients were not significantly different. According to the obtained results, this hypothesis has also been rejected, and there is no difference between the profiles of healthy eating in the non-acne and acne group.

Regarding the consumption of milk, studies such as the study by Adebamowo and his colleagues concluded that the consumption of whole milk and skimmed milk significantly increases the severity of acne. The relationship with milk may be due to the presence of hormones and biologically active molecules in milk [41]. However, other studies, such as Okoro et al.'s study in 2016, which was conducted on women, concluded that the prevalence of acne was higher among those who reported the minimum daily consumption of milk as a drink, and a negative correlation was seen. It has also been seen in this study that the consumption of corn, fried beef, and cake has a significant relationship with acne, and students who consume more bananas have less acne [42]. Burris and his colleagues showed that diet, especially glycemic index, saturated fat, trans fat, milk, and fish, may affect the growth of acne [43].

Moreover, one study showed a connection with the daily consumption of 25 g of sunflower seeds per day for one week, and the severity of acne intensified. In the present study, no significant relationship was found with acne ($p = 0.429$) by examining the nuts consumed as a dried fruit group [44].

In the present study, there was no significant relationship between the status of ORAC and acne. In the study of Saric and his colleagues, which is a review study and investigated polyphenols as antioxidants in relation to acne, some studies suggested the relationship of polyphenols in the significant reduction of acne, and others showed a significant relationship between the consumption of polyphenols and the disease [45]. In the conducted searches, no study was found regarding the state of ORAC with acne. According to the findings of the present study, there seems to be no relationship between these two factors, and this issue is consistent with the findings of past studies.

Conclusion

Based on the present study no association have been found between anthropometric profiles, dietary oxygen radical absorption capacity and healthy eating index with acne. These results might be due to several factors

including the method of the study, sample size and using food frequency questionnaire which might lead to under or over reporting [46, 47]. According to the present study, it seems acne incidence is more likely personal and it is hard to conclude a tangible relationship between food factors with it. It is possible to have different result in a large sample size cohort study. Therefore, further large-scale studies on this issue are highly recommended.

Limitations

Food intake of this study was based on FFQ, despite its validity for this type of research it was better to do such a study by using food diary in the future. Authors confirm that all methods were carried out in accordance with relevant guidelines and regulations.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s13104-025-07160-z.

Supplementary Material 1

Author contributions

AK was co-adviser and AM was the head of the project and data analysis. MA was responsible for collecting data and entering. GM and ZM were responsible for writing the main draft of the article. AK were responsible for editing the first draft of the article.

Funding

Not applicable.

Data availability

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

This study was approved by the Iran National Committee for Ethics in Biomedical Research under the document code IR.IAU.TMU.REC.1398.203. The subjects of the study, the objectives of the research and the method of its implementation were fully explained to the eligible people, and then they were asked to sign a written consent form if they were willing to cooperate.

Consent for publication

Not Applicable.

Competing interests

The authors declare no competing interests.

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