ORİJİNAL ARAŞTIRMA ORIGINAL RESEARCH

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Determination of the Effect of Diet on the Development and Severity of Acne Vulgaris by Using Insulin Index and Glycemic Index

İnsülin İndeksi ve Glisemik İndeks Kullanılarak Diyetin Akne Vulgaris Oluşumu ve Şiddeti Üzerindeki Etkisinin Belirlenmesi

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ABSTRACT Objective: Acne vulgaris is a chronic, inflammatory disease of the pilosebaceous unit. Dietary factor is considered to be one of the factors that can trigger acne vulgaris as it is reported to be associated with Western type nutrition. In this study, it is aimed to evaluate the effect of insulin index and dietary factors in patients with acne vulgaris. **Material and Methods:** Two hundred two consecutive patients with acne vulgaris and 172 patients as control group were included in this study. The dietary habits in patients with acne vulgaris were statistically compared to the control group. **Results:** The risk for acne was detected increased in those consuming more than 3 servings per week for cola (Odds ratio (OR) 1.57; 1.00-2.46), instant coffee with powdered milk (OR 1.67; 1.03-2.72), feta cheese (OR 1.63; 1.00-2.65) and 1 serving per week for peanut (OR 1.62; 1.02-2.58) while risk for acne was decreased in those consuming more than 3 servings per week for chicken meat (OR 0.65; 0.43-0.99), pasta (OR 0.59; 0.37-0.95), and 1 serving per week for sujuk (OR 0.60; 0.38-0.94) ($p<0.05$). **Conclusion:** In this study, the consumption of foodstuffs with a higher insulin index value than glycemic index such as cola, feta cheese, and peanuts was significantly higher in patients with acne vulgaris. It may be useful to take into consideration the value of insulin index along with the glycemic index value for some foodstuffs to evaluate relationship between acne vulgaris and dietary factors.

Keywords: Acne; diet; glycemic index; insulin index

ÖZET Amaç: Akne vulgaris, pilosebase ünitenin kronik inflamatuar bir hastalığıdır. Batı tipi beslenmeyle ilişkili olduğu bildirilen akne vulgaris için diyet tetikleyici bir faktördür. Bu çalışmada insulin indeks ve diyet faktörlerinin akne vulgaris üzerindeki etkisinin incelenmesi amaçlanmıştır. **Gereç ve Yöntemler:** İki yüz iki akne vulgarisli hasta ile 172 kontrol grubu bu çalışmaya dahil edildi. Akne vulgarisli hastalarda diyet alışkanlıkları kontrol grubuyla istatistiksel olarak karşılaştırıldı. **Bulgular:** Haftada ≥3 porsiyon kola (Odds oranı (OO) 1,57; 1,00-2,46), süt tozlu neskafe (OO 1,67; 1,03-2,72) beyaz peynir (OO 1,63; 1,00-2,65) ile haftada ≥1 porsiyon fıstık (OO 1,62; 1,02-2,58) tüketenlerde akne vulgaris riski yüksek bulunurken haftada ≥3 porsiyon tavuk eti (OO 0,65; 0,43-0,99), makarna (OO 0,59; 0,37-0,95) ile haftada ≥1 porsiyon sucuk (OO 0,60; 0,38-0,94) tüketenlerde akne vulgaris riski düşük bulundu. **Sonuç:** Bu çalışmada, insulin indeks değeri glisemik indeks değerinden yüksek olan kola, beyaz peynir ve fıstık tüketimi akne vulgarisli hastalarda anlamlı olarak fazla bulundu. Akne vulgaris ile diyet faktörleri arasındaki ilişkinin değerlendirilmesinde glisemik indeks yanında insulin indeksini de değerlendirmek faydalı olabilir.

Anahtar Kelimeler: Akne; diyet; glisemik indeks; insulin indeks

Acne vulgaris (AV) is a chronic, inflammatory disease of the pilosebaceous unit and may affect all age groups, although it usually occurs in adolescents. Four major factors in the pathogenesis of acne include increased sebum production, abnormal follicular keratinization, *Propionibacterium acnes* (*P. acnes)* proliferation and inflammation.[1,2] Pilosebaceous unit activity is controlled by androgen hormones. Obesity is currently a major health problem and is frequently associated with peripheral hyperandrogenism. Since carbohydrate-rich Western type diet has become widespread especially in recent years and the patients with AV are often on this diet, diet factor is considered likely to be one of the factors that trigger the dis-

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ease.[3,4] The high glycemic index, a typical feature of the Western type diet, is often associated with an increase in body fat. In individuals, who are on a high-glycemic index, Western-type diet, increased mTORC1 signal production and relative deficiency of FoxO1 may cause acne lesions to occur, resulting in obesity.[5-8] The Western-type diet disrupts FoxO1-mediated gene regulation, high glycemic load and consumption of milk proteins increase both insulin and IGF-1 signaling, which increases in puberty, providing an additional load.[5,7-10]

Insulin index measures the effect of food on insulin levels in blood two hours after a meal. On the other hand, glycemic index measures the effect of carbohydrates in food on glucose levels in the blood.[11] Although there is a correlation between glycemic index and insulin index for a large number of foodstuffs, red meat, chicken meat do not have any glycemic index value as they do not have any carbohydrate value. Therefore, when the dietary factors for AV are examined individually, the glycemic index value is not enough alone to determine the relationship between dietary factors and AV. It is reported that the risk of AV will be reduced by consuming food with a low insulin index diet.[12] Several studies have been conducted to determine the relationship between dietary factors and acne vulgaris. In these studies, it is highlighted that high glycemic index diet may trigger AV.[3,13-16]

The relationship of numerous foodstuffs with acne vulgaris has not been yet studied. This study aims to investigate the effect of a large number of foodstuffs on acne by applying a food frequency questionnaire and to evaluate foodstuffs which trigger AV in terms of insulin index as a new approach.

MATERIAL AND METHODS

1. STUDY DESIGN

This was a prospective study performed in the Department of Dermatology and Venereology of the Health Sciences University, Ankara Training and Research Hospital. Two hundred two consecutive patients with acne vulgaris and 172 patients with callus, insect bites, and verruca vulgaris were included. Two groups had similar age, gender, and demographic characteristics. A diet questionnaire was applied to these two groups, which questions the daily and weekly consumption frequency of solid and liquid foodstuffs with standardized servings. Global Acne Grading Scales (GAGS) was used to determine the severity of acne.[17] Dietary characteristics of the AV group and the control group were compared with each other. In the AV group, the severity of disease and dietary factors were also examined. Ethics committee approval was obtained from the Hospital Education Planning and Coordination Board (2017/0671-5633).

DIETARY FACTORS

Standardized food frequency questionnaire was performed to the patients and control groups.One serving size was standardized as 1 cup (200 ml) for liquid foods, while 1 serving size was standardized in solid foods as follows: Red meat 1 tablespoon, fish-chicken meat 1 egg size, sausage 1 piece, salami 1 slice, sujuk 4 ring slices, dry beans 5 tablespoons, yogurt-lentil soup 1 small bowl, feta cheese-cheddar cheese-chocolate 1 matchbox, cake 1 slice, potato chips 1 box (25 g), peanut-hazelnut-sunflower 1 teacup, rice pilaf- pasta 2 tablespoons, potato 1 medium size, egg-bagels 1 piece, honey 1 teaspoon, apple 1 small size, orange 1 medium size, tangerine 2 small size, banana 1 small size, grape 15 large grapes, peach 1 medium size and watermelon 1 slice.

Skimmed milk, fatty milk, cola, buttermilk, juice, milk powdery instant coffee, red meat, sausage, salami, yogurt, feta cheese, cheddar cheese, cake, potato chips, chocolate, lentil soup, rice pilaf, pasta, potatoes, bagels, eggs, apples, oranges, tangerines, bananas, grapes, peaches and watermelon consumption is divided in two groups as $\geq$3 and <3 per week; beer, fish meat, sausage, dried beans, peanuts, hazelnuts, sunflower seeds consumption as $\geq$1 and <1 per week while honey consumption was divided into two groups as $\geq$7 and <7 per week. The frequency of food consumption between the patient and control groups was compared based on the food groups and criteria.

The insulin index of a food is described as how much it raises the concentration of insulin in the blood during the two-hour period after the food is ingested. The insulin index compares foods in amounts with equal complete caloric content (250 kcal or 1000 kJ) and is scaled relative to white bread.[11]

STATISTICAL ANALYSIS

Data were analyzed using SPSS 20.0 program and statistical significance was determined as $p<0.05$. Variables in the study were analyzed with descriptive statistics using their frequencies and percentages. Shapiro-Wilk tests were used to determine normality. Numeric variables were expressed as mean±standard deviation for normal distribution, or, if not, as median. Pearson's Chi-square test and Fisher exact test were used for categorical data differences between groups. The odds ratio was obtained to quantify the strength of the association between groups. Bivariate correlation analysis was used for the correlation between categorical variables. The combined effect of all risk factors on the presence of acne in AV patients was investigated by backward stepwise binary logistic regression model: Wald method. Independent Samples t test was used for data normally distributed, while Mann-Whitney U test was for data not normally distributed in continuous variables.

RESULTS

The study was conducted on 202 AV patients and 172 patients in the control group. The number of women enrolled in the study was 223 (59.6%) and the number of men was 151 (40.4%). Of the patients, 132 (65.3%) female and 70 (34.7%) male patients constituted the group with acne vulgaris. Any statistically significant difference was not found between the patient and control groups in terms of age, sex distribution and socio-economic factors (occupation, marital status, education level, and monthly income. p values were 0.703, 0.971, 0.672, 0.098, respectively).

In terms of acne severity, the mean score was 20.72±8.23 according to GAGS. According to this scoring, 72 (35.6%) patients showing mild, 95 (47%) moderate, 28 (13.9%) severe and 7 (3.5%) very severe acne. In the AV group, the median body mass index (BMI) was 21.43 (minimum 16.30, maximum 38.76) kg/m^2 while 21.53 (minimum 14.65, maximum 33.20) kg/m^2 in control group. There is no statistically significant difference between the AV and control groups in terms of average BMI value (p=0.682).

Patients were inquired about factors that triggered AV. One hundred twenty-seven (64.5%) patients reported that AV was triggered by diet. These patients were also examined for foodstuffs that can cause AV (Figure 1). Foods with a statistically significant difference in consumption between the AV and the control group are shown in Table 1. As a result of step 6 with logistic regression analysis, ≥3 servings of cola, instant coffee with powdered milk, feta cheese, and ≥1 serving of peanuts consumption were significantly higher in patients with AV (p values were 0.034, 0.037, 0.014, 0.031, respectively). On the contrary, ≥3 servings of chicken meat, pasta and ≥1 serving of sujuk consumption per week were found to be statistically significantly higher in the control group (p values were 0.008, 0.011, 0.002, respectively). Table 2 shows the foodstuffs that have a statistically significant difference in consumption between the AV and the control group by using the logistic regression analysis. There is no statistically significant difference between the frequency of fruit consumption and GAGS score in the group with acne vulgaris (Table 3).

There was a significant positive correlation between cola, hazelnut consumption and GAGS score, while negative correlation between tangarine and GAGS score (p values were 0.018, 0.048, and 0.026 while correlations coefficients were 0.166, 0.140, and -0.210, respectively.)

DISCUSSION

Acne vulgaris is a chronic inflammatory disease of the pilosebaceous unit, which is frequently located in

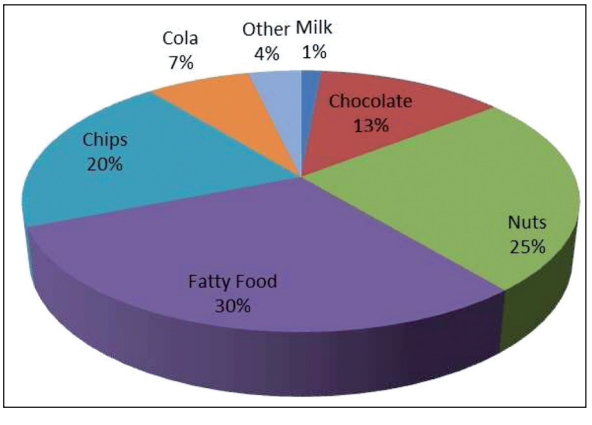

FIGURE 1: Diet factors known to stimulate acne vulgaris.

TABLE 1: Foodstuffss with significant difference between acne vulgaris and control group.

	Consumption (%)				
	Serving size	Groups			Odds Ratio
Type of food	(serving/week)	AV (%)	Control (%)	p* value	95% Confidence Interval
Cola	≥3	37.1	27.3	0.048	1.57 (1.000-2.460)
Chicken meat	≥3	39.1	49.7	0.044	0.650 (0.428-0.988)
Sujuk	≥1	25.2	36.0	0.026	0.60 (0.382-0.943)
Feta cheese	≥3	80	71.1	0.049	1.63 (1.000-2.651)
Peanuts	≥1	34.5	24.5	0.041	1.621 (1.019-2.578)
Pasta	≥3	22.5	32.9	0.028	0.592 (0.370-0.946)
Grapes*	≥3	34.8	65.2	0.035	0.386 (0.156-0.957)

The Chi-Square test was used. *Found to be significant for 12-18 years of age.

TABLE 2: Effects on acne vulgaris when consumed together with dietary factors.

					OR 95% Confidence Interval	
Type of food	B	Wald	p* value	OR	Minimum	Maximum
Cola	0.537	4.498	0.034	1.710	1.042	2.809
Instant Coffee with Powdered Milk	0.515	4.332	0.037	1.674	1.031	2.720
Chicken meat	-0.638	7.132	0.008	0.528	0.331	0.844
Sujuk	-.0820	10.078	0.002	0.440	0.265	0.731
Feta cheese	0.683	6.075	0.014	1.980	1.150	3.407
Peanuts	0.571	4.630	0.031	1.769	1.052	2.976
Pasta	-0.690	6.501	0.011	0.502	0.295	0.852

* Backward stepwise binary logistic regression model: Wald method step 6 R2: 0.112. B: Regression load; OR: Odds ratio.

TABLE 3: Relationship between the frequency of fruit consumption and GAGS score in patients with acne.

Type of food	Serving size (serving/week)	Mean GAGS score	Serving size (serving/week)	Mean GAGS score	p value
Apple	≥3	20.17 ± 8.65	<3	21.10 ± 7.7	0.371
Orange	≥3	19.88 ± 7.60	<3	21.18 ± 8.62	0.184
Tangerine*	≥3	19.67 ± 8.53	<3	21.16 ± 7.99	0.198
		20.45 ± 8.66		23.64 ± 7.77	<0.05
Banana	≥3	21.72 ± 8.62	<3	20.29 ± 8.08	0.350
Grape	≥3	19.77 ± 6.92	<3	20.68 ± 8.30	0.711
Peach	≥3	19.48 ± 8.15	<3	20.76 ± 8.22	0.475
Watermelon	≥3	21.69 ± 8.16	<3	20.31 ± 8.21	0.308

GAGS: Global Acne Grading System.

*The mean GAGS score was significantly lower in the 18-year age group consuming ≥3 servings of tangerine per week (20.45±8.66), compared to those consuming <3 servings per week (23.64 ± 7.77).

the face and reaches a peak in the adolescence. AV is more common in the adolescence and its incidence decreases with age. The disease, which is more common in female, occurs a more severe course in male.[18] Studies on the pathogenesis of AV, have recently focused on *P. acnes* and adaptive/natural immune system activation against sebum content as well as Western-type nutrition.[16,18,19] In order to determine the relationship between acne vulgaris and diet, a number of studies have been performed by applying food frequency questionnaires (Table 4). In these studies, the relationship between glycemic index-based food con-

TABLE 4: Studies investigating diet and acne.

Reference	Design	Participants	Results	Years
Ismail NH et al.[13]	Case control	44 acne vulgaris patients and 44 controls aged 18 to 30 years.	The frequency of milk and ice-cream consumptions was significantly higher in acne compared to controls.	2012
Karadağ et al.[15]	Case control	A total of 3826 acne vulgaris patients and 759 control patients with all age	There was statistically significant relationship between acne severity and dietary factors such as chocolate, dairy products such as milk, sunflower seed consumption.	2019
Burris J, et al.[16]	Cross-sectional	A total of 248 (115 male, 133 female) participants, age 18 to 25 years.	Participants with moderate to severe acne reported frequent consumption of total sugar, milk, saturated fat, and trans-fatty acids, and fewer fish.	2014
Ghodsi SZ, et al.[27]	Cross-sectional	1002 participants,793 participants with mild acne,140 participants with moderate severe acne, 68 participants without acne, ages 12-20 years.	Acne was positively associated with sweets, nuts , chocolate, and oily foods	2009
Jung JY, et al.[28]	Cross-sectional	1,285 participants, 783 participants with acne, 502 age-matched controls, mean age 24 years	Acne was positively associated with instant noodles, junk food, carbonated drinks, processed cheese, braised pork, roasted pork, fried chicken, stewed chicken, nuts , and seaweed consumption.	2010
Law M, et al.[29]	Cross-sectional	322 participants, 82 patients with acne, 240 healthy controls, ages 17.4-20.8 y	Acne was positively associated with dessert, fruit juice and negatively associated dairy and soy among a subset of participants	2010
Youssef EN, et al.[30]	Case control	60 participants, 230 male and female acne patients aged 17-30 years	Chocolate, peanut, vegetables, cola & fast food are associated with severity of acne.	2014
El-Fetoh A, et al.[31]	Cross-sectional	403 adolescent participants	Patientes reported that 33.8% eating of chocolate, 31.3%fatty meals, 4.0% with spicy food, 2.9% with excess carbonated beverages drinks increase acne	2016
Huang X, et al.[34]	Cross-sectional	8226 students participants	Frequent intake of carbonated sodas, sweetened tea drinks and fruit flavored drinks was associated with moderate-to-severe acne.	2019

sumption and AV has been investigated mostly regarding fish meat, milk/dairy products, and chocolate.[20-22] There are conflicting results in different studies on the effect of BMI on AV development as in certain other skin diseases.[23-26] In this study, there is no statistically significant difference in mean BMI between the patients with AV and the control group. In this regard, it can be considered that the absence of acne vulgaris development in obese patients may be associated with a low number of patients with BMI ≥30 kg/m^2. In current study, a total of 8 obese individuals were included and 4 (2%) were in the AV group and 4 (2.5%) were in the control group.

Six thousand ninety four female and 4273 male patients, aged 9-15, participated in two different prospective cohort studies, in which it was shown that ≥2 servings of milk consumption increased the risk of AV in females by 20% compared to those consuming <2 servings, and this increase was 16% in males.[12,13] In the study conducted by Ghodsi et al. with 1002 students, sugar and fatty food consumption was reported to be a risk factor for AV development. In contrast, no association was found in spicy food.[27] In a prospective study conducted by Jung et al. with 783 AV patients and 502 control subjects, fish and vegetable consumption was found to be significantly higher in the control group whereas chicken meat, processed cheeses, carbonated beverages, and hazelnut consumption was statistically higher in the AV group.[28] In a retrospective study conducted by Law et al., involving 82 AV patients and 240 patients in

the control group, aged 17.4-20.8, it was reported that dessert and juice triggered AV.[29] Karadağ et al. reported that white sugar, dairy products, ice cream and white bread may increase acne severity. On the other hand, an inverse proportion was reported between whole wheat bread, fish, and legumes and acne development.[15] In our study, the consumption of cola, feta cheese, peanut and instant coffee with powdered milk was found to be statistically higher in the AV group compared to the control group. On the other hand, chicken meat, sujuk, pasta and in 12-18 age group grape consumption was significantly higher in the control group than in the AV group. Youssef et al. reported in their study where they applied food consumption frequency questionnaire to 230 AV patients, aged 17-30, and 230 healthy volunteers, cola consumption was more frequent in the AV group than in the control group and it was found that the severity of AV increased as the cola consumption frequency increased.[30] In the study conducted by El-Fetoh et al., 9.9% of the patients with AV state that cola is a triggering factor for AV when they were asked about AV-triggering foodstuffs.[31] In our study, ≥3 servings of cola consumption per week were found to be significantly higher in the acne group than in the control group. The estimated relative risk for acne development in patients consuming ≥3 servings of cola per week was 1.57 (1.00-2.46), while this value was 2.261 (1.260-4.059) for 12-18 years of age. When cola consumption and GAGS score are examined as continuous variables, a positive correlation was found between them. As cola consumption increased, acne severity also increased. The insulin index value of cola, which has a low glycemic index value, is 45 and it is higher than the insulin index value of a high number of foodstuffs. It may be suggested that the mechanism by which cola triggers AV is associated with high insulin index.

In a prospective study conducted by Jung et al., 783 patients with AV and 502 patients in the control group were compared with each other and the frequency of processed cheese consumption in the group with AV was significantly higher than in the control group.[28] In our study, the risk of AV formation was significantly higher in feta cheese consumers, which is consistent with the literature. The odds ratio for AV was 1.628 (1.000-2.651) for those who consumed ≥3 servings of feta cheese per week.

In the study performed by El-Akawi et al., they examined their 166 untreated AV patients, about the items that triggered acne formation, 12.1% of the patients reported tea and coffee as acne-triggering agents.[32] In our study, the estimated relative risk for development of AV was 1.628 (1.00-2.651) for those consuming ≥3 servings of instant coffee with powdered milk. It can be thought that the insulinotropic effect of powdered milk within the instant coffee may cause acne development. The possible effect of coffee on development of AV should be clarified with new studies. There are conflicting results in the literature regarding nuts consumption and AV triggering.[24,30,33] In this study, the estimated relative risk ratio for development of AV was 1.621 (1.019-2.578) for those consuming ≥1 serving of peanuts per week.

In recent studies, apart from the consumption frequency of foodstuffs with high glycemic index values, the consumption frequency of certain foodstuffs with low glycemic index value was also found to be high in AV patients.[16,34,35] In this regard, we found that acne is triggered by foodstuff such as feta, cola, cheese, and peanut in which insulin index value was higher than glycemic index value. This result may suggest that insulin index may be used as another marker for AV-triggering foodstuffs. Foodstuffs with high insulin index value more increase blood glucose level than foodstuffs with low insulin index value and reduce FoxO1-mediated gene expression that is a nutritionally sensitive transcription factor and plays a major role in pathogenesis of acne by the action of phosphoinositide-3-kinase (PI3K)/AKT (protein kinase B), mTORC1 and sterol regulatory element-binding protein-1.[13,19,36,37]

Jung et al. found a high risk of AV in chicken meat consumers.[28] In contrast to this result, we found that chicken meat consumption was higher in the control group than in the AV group. The estimated relative risk for those consuming ≥3 servings of chicken per week was 0.650 (0.428-0.988). The low risk of AV formation due to chicken meat consumption may be considered to be compatible with the lack of chicken meat in the Western-type diet.

In this study, the estimated relative risk for AV development in those consuming ≥1 serving of sujuk per week was 0.6 (0.382-0.943). This result may be considered consistent with the result of the study conducted by Ghodsi et al. in which they reported that spicy foods did not trigger AV.[27] In this study, pasta consumption was also significantly higher in the control group than in the AV group. The estimated relative risk for development of AV in patients consuming ≥3 servings of pasta per week was 0.592 (0.370-0.946). The glycemic index value of pasta varies by the type of pasta. This is 41 for spaghetti, 32 for the "fettucini", 68 for the "gnocchi" and 55 for the "linguine". The varieties of pasta were not specified in the questionnaire, which might have affected the results. However, the glycemic index value is low-medium (<70) and the insulin index value is <40 in all varieties of pasta, which may explain that pasta may be a low-risk foodstuff in acne development.

In this study, the relationship between food consumption and disease severity was also investigated in patients with AV. When the patients with AV were examined about their hazelnut consumption, GAGS score was significantly higher in those who consumed ≥1 serving per week (22.83±8.9) compared to those consuming <1 serving per week (19.84±8.22). The positive correlation was also found between the severity of acne and hazelnut consumption.

Conflicting results have been reported when the relationship between the frequency of fruit consumption and AV formation/severity is investigated.[30,32,38] It has been suggested that consumption of fruits and vegetables prevents AV formation by causing a decrease of activation in mTORC1 signaling pathway.[19] In a study conducted by El Akawi et al., 19% of patients with AV reported that the consumption of vegetables and fruits healed the AV lesions.[32] In our study, the number of individuals consuming ≥3 servings of grapes per week in the group of 12-18 years old was higher in the control group than in the acne group. In the control group, the high amount of grape consumption may indicate that grapes may be a preventive food in AV development. The clinical results obtained in this study were consistent with in vitro results demonstrating that resveratrol inhibited *P. acnes* with its antimicrobial effect.[39,40] Although the acne severity was lower in patients who consumed ≥ 3 servings of fruits per week than those consuming <3 servings per week, there was not statistically significant difference between acne severity and fruit consumption. When the relationship between ≥3 servings of tangerine consumption per week and acne severity was investigated, the mean GAGS score (20.45±8.66) was statistically lower than those who consumed <3 servings of tangerine per week (23.64±7.77) in the group aged 12-18 years. A statistically significant negative correlation was found between ≥3 servings of tangerine consumption per week and acne severity in AV subjects aged 12-18 years. As the amount of tangerine consumption increased, the severity of acne decreased. It can be speculated that one of the factors of fruits such as grapes and tangerines reducing on the severity and the development of acne may be associated with the antioxidant effect of these fruits.

CONCLUSION

In the literature, although certain studies have been conducted to investigate the relationship between glycemic index and glycemic load and acne vulgaris, there is no study focusing on the relationship between insulin index value and acne. It will be useful to take into consideration the value of insulin index along with the glycemic index value for some foodstuffs when acne vulgaris is evaluated with dietary factors. In addition, when the role of fruits such as grapes and tangerine in acne development and severity is clarified, vitamin/food supplements can be suggested for supporting treatment in patients with AV.

Source of Finance

During this study, no financial or spiritual support was received neither from any pharmaceutical company that has a direct connection with the research subject, nor from a company that provides or produces medical instruments and materials which may negatively affect the evaluation process of this study.

Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

Idea/Concept: *Meral Ekşioğlu;* ***Design:*** *Ömer Kutlu;* ***Control/Supervision:*** *İlknur Balta;* ***Data Collection and/or Processing:*** *Ömer Kutlu;* ***Analysis and/or Interpretation:*** *Meral Ekşioğlu, İlknur Balta, Ömer Kutlu;* ***Literature Review:*** *Ömer Kutlu;* ***Writing the Article:*** *Ömer Kutlu;* ***Critical Review:*** *Meral Ekşioğlu, İlknur Balta.*

REFERENCES

1. Williams HC, Dellavalle RP, Garner S. Acne vulgaris. Lancet. 2012;379(9813):361-72. [Crossref] [PubMed]
2. Kutlu Ö, Balta İ, Karaarslan E, Nalbant EEK, İmren G, Ekşioğlu HM. Facial paralysis probably related to systemic isotretinoin. Int J Sci Rep. 2019;5(5):130-2. [Crossref]
3. Cordain L, Lindeberg S, Hurtado M, Hill K, Eaton SB, Brand-Miller J. Acne vulgaris: a disease of Western civilization. Arch Dermatol. 2002;138(12):1584-90. [Crossref] [PubMed]
4. Juhl C, Bergholdt H, Miller I, Jemec GBE, Kanters JK, Ellervik C. Dairy intake and acne vulgaris: a systematic review and meta-analysis of 78,529 children, adolescents, and young adults. Nutrients. 2018;10(8):1049. [Crossref] [PubMed] [PMC]
5. Melnik BC, John SM, Plewig G. Acne: risk indicator for increased body mass index and insulin resistance. Acta Derm Venereol. 2013;93(6):644-9. [Crossref] [PubMed]
6. Cheng Z, White MF. Targeting Forkhead box O1 from the concept to metabolic diseases: lessons from mouse models. Antioxid Redox Signal. 2011;14(4):649-61. [Crossref] [PubMed] [PMC]
7. Dong XC, Copps KD, Guo S, Li Y, Kollipara R, DePinho PA, et al. Inactivation of hepatic Foxo1 by insulin signaling is required for adaptive nutrient homeostasis and endocrine growth regulation. Cell Metab. 2008;8(1):65-76. [Crossref] [PubMed] [PMC]
8. Foster KG, Fingar DC. Mammalian target of rapamycin (mTOR): conducting the cellular signaling symphony. J Biol Chem. 2010;285(19):14071-7. [Crossref] [PubMed] [PMC]
9. Tan JK, Vasey K, Fung KY. Beliefs and perceptions of patients with acne. J Am Acad Dermatol. 2001;44(3):439-45. [Crossref] [PubMed]
10. Kim H, Moon SY, Sohn MY, Lee WJ. Insulin-like growth factor-1 increases the expression of inflammatory biomarkers and sebum production in cultured sebocytes. Ann Dermatol. 2017;29(1):20-5. [Crossref] [PubMed] [PMC]
11. Holt S, Miller J, Petocz P. An insulin index of foods: the insulin demand generated by 1000-kJ portions of common foods. Am J Clin Nutr. 1997;66(5):1264-76. [Crossref] [PubMed]
12. Melnik BC. Evidence for acne-promoting effects of milk and other insulinotropic dairy products. Nestle Nutr Workshop Ser Pediatr Program. 2011;67:131-45. [Crossref] [PubMed]
13. Ismail NH, Manaf ZA, Azizan NZ. High glycemic load diet, milk and ice cream consumption are related to acne vulgaris in Malaysian young adults: a case control study. BMC Dermatol. 2012;12:13. [Crossref] [PubMed] [PMC]
14. Kwon HH, Yoon JY, Hong JS, Jung JY, Park MS, Suh DS. Clinical and histological effect of a low glycaemic load diet in treatment of acne vulgaris in Korean patients: a randomized, controlled trial. Acta Derm Venereol. 2012;92(3):241-6. [Crossref] [PubMed]
15. Karadağ AS, Balta İ, Saricaoğlu H, Kiliç S, Kelekçi KH, Yildirim M, et al. The effect of personal, familial, and environmental characteristics on acne vulgaris: a prospective, multicenter, case controlled study from Turkey. G Ital Dermatol Venereol. 2019;154(2):177-85. [Crossref] [PubMed]
16. Burris J, Shikany JM, Rietkerk W, Woolf K. A low glycemic index and glycemic load diet decreases insulin-like growth factor-1 among adults with moderate and severe acne: a short-duration, 2-week randomized controlled trial. J Acad Nutr Diet. 2018;118(10):1874-85. [Crossref] [PubMed]
17. Doshi A, Zaheer A, Stiller MJ. A comparison of current acne grading systems and proposal of a novel system. Int J Dermatol. 1997;36(6):416-8. [Crossref] [PubMed]
18. Gollnick H, Cunliffe W, Berson D, Dreno B, Finlay A, Leyden JJ, et al. Management of acne: a report from a global alliance to improve outcomes in acne. J Am Acad Dermatol. 2003;49(1 Suppl):S1-37. [PubMed]
19. Melnik B. Dietary intervention in acne: attenuation of increased mTORC1 signaling promoted by Western diet. Dermatoendocrinol. 2012;4(1):20-32. [Crossref] [PubMed] [PMC]
20. Claudel JP, Auffret N, Leccia MT, Poli F, Dréno B. Acne and nutrition: hypotheses, myths and facts. J Eur Acad Dermatol Venereol. 2018;32(10):1631-7. [Crossref] [PubMed]
21. Khayef G, Young J, Burns-Whitmore B, Spalding T. Effects of fish oil supplementation on inflammatory acne. Lipids Health Dis. 2012;11:165. [Crossref] [PubMed] [PMC]
22. Dai R, Hua W, Chen W, Xiong L, Li L. The effect of milk consumption on acne: a meta-analysis of observational studies. J Eur Acad Dermatol Venereol. 2018;32(12):2244-53. [Crossref] [PubMed]
23. Lu PH, Hsu CH. Body mass index is negatively associated with acne lesion counts in Taiwanese women with post-adolescent acne. J Eur Acad Dermatol Venereol. 2015;29(10):2046-50. [Crossref] [PubMed]
24. Burris J, Rietkerk W, Woolf K. Relationships of self-reported dietary factors and perceived acne severity in a cohort of New York young adults. J Acad Nutr Diet. 2014;114(3):384-92. [Crossref] [PubMed]
25. Seleit I, Bakry OA, Abdou AG, Hashim A. Body mass index, selected dietary factors, and acne severity: are they related to in situ expression of insulin-like growth factor-1? Anal Quant Cytopathol Histopathol. 2014;36(5):267-78. [PubMed]
26. Tanacan E, Karaosmanoğlu N, Kutlu Ö, Ekşioğlu HM. [Evaluation of the relationship between androgenetic alopecia severity and body mass index]. Ankara Eğt Arş Hast Derg. 2018;51(3):193-5.
27. Ghodsi SZ, Orawa H, Zouboulis CC. Prevalence, severity, and severity risk factors of acne in high school pupils: a community-based study. J Invest Dermatol. 2009;129(9):2136-41. [Crossref] [PubMed]
28. Jung JY, Yoon MY, Min SU, Hong JS, Choi YS, Suh DH. The influence of dietary patterns on acne vulgaris in Koreans. Eur J Dermatol. 2010;20(6):768-72. [PubMed]
29. Law MP, Chuh AA, Molinari N, Lee A. An investigation of the association between diet and occurrence of acne: a rational approach from a traditional Chinese medicine perspective. Clin Exp Dermatol. 2010;35(1):31-5. [Crossref] [PubMed]
30. Youssef EN, Youssef MKE. Diet and acne in Upper Egypt. Am J Dermatol Venereol. 2014;3(1):13-22.

31. Abo El-Fetoh NM, Alenezi NG, Alshamari NG, Alenezi OG. Epidemiology of acne vulgaris in adolescent male students in Arar, Kingdom of Saudi Arabia. J Egypt Public Health Assoc. 2016;91(3):144-9. [Crossref] [PubMed]

32. El-Akawi Z, Abdel-Latif Nemr N, Abdul-Razzak K, Al-Abbosi M. Factors believed by Jordanian acne patients to affect their acne condition. East Mediterr Health J. 2006;12(6):840-6. [PubMed]

33. Tom WL, Barrio VR. New insights into adolescent acne. Curr Opin Pediatr. 2008;20(4): 436-40. [Crossref] [PubMed]

34. Huang X, Zhang J, Li J, Zhao S, Xiao Y, Huang Y, et al. Daily intake of soft drinks and moderate-to-severe acne vulgaris in Chinese Adolescents. J Pediatr. 2019;204:256-62.e3. [Crossref] [PubMed]

35. Romańska-Gocka K, Woźniak M, Kaczmarek-Skamira E, Zegarska B. The possible role of diet in the pathogenesis of adult female acne. Postepy Dermatol Alergol. 2016;33(6):416-20. [Crossref] [PubMed] [PMC]

36. Melnik BC. Diet in acne: further evidence for the role of nutrient signaling in acne pathogenesis. Acta Derm Venereol. 2012;92(3): 228-31. [Crossref] [PubMed]

37. Inoki K, Ouyang H, Li Y, Guan KL. Signaling by target of rapamycin proteins in cell growth control. Microbiol Mol Biol Rev. 2005;69(1):79-100. [Crossref] [PubMed] [PMC]

38. Fouladi RF. Aqueous extract of dried fruit of Berberis vulgaris L. in acne vulgaris, a clinical trial. J Diet Suppl. 2012;9(4):253-61. [Crossref] [PubMed]

39. Docherty JJ, McEwen HA, Sweet TJ, Bailey E, Booth TD. Resveratrol inhibition of Propionibacterium acnes. J Antimicrob Chemother. 2007;59(6):1182-4. [Crossref] [PubMed]

40. Taylor EJ, Yu Y, Champer J, Kim J. Resveratrol demonstrates antimicrobial effects against Propionibacterium acnes in vitro. Dermatol Ther (Heidelb). 2014;4(2):249-57. [Crossref] [PubMed] [PMC]