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Epidemiological characteristics of different types of adult acne in Turkey: a prospective, controlled, multicenter study

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Abstract

Introduction: Acne occurring in adults over the age of 25 years is known as acne tarda or adult acne. Three types of adult acne are recognized: persistent, late-onset, and recurrent acne. Most studies do not compare the characteristics between the three variants. In addition, little is known about adult acne in males. This study describes the epidemiological factors of adult acne and investigates certain triggering factors by sex and different types of adult acne.

Methods: A multicenter, prospective, descriptive study was conducted. Patients with adult acne and an acne-free control group were compared regarding medical history, family history, smoking and drinking habits, and dietary factors. In addition, triggering and prognostic factors were investigated by sex and three different types of acne: persistent, late-onset, and recurrent acne.

Results: The participants included 944 (88.56%) female and 122 (11.44%) male patients with adult acne, and 709 (73.85%) female and 251 (26.15%) male control patients. The consumption of crackers, chocolate, and pasta was significantly more common in the acne group than in the control group (p = 0.017, 0.002, and 0.040, respectively). Male patients with adult acne had a significantly longer disease duration than female patients with adult acne (p = 0.024). The most common type of acne was recurrent acne, followed by persistent and late-onset acne. Among patients with persistent acne, 14.5% had polycystic ovary syndrome (PCOS), whereas 12.2% of patients with recurrent acne and 11.1% of patients with late-onset acne had PCOS. Severe acne was more common in the persistent acne type (28.13%). The cheek (59.90%) was the most common involvement area, and stress (55.23%) was the most common triggering factor regardless of sex.

Conclusions: Although adult female and male patents with adult acne share similar triggering factors, the involvement areas can differ, which may indicate the additional hormonal etiology of female adult acne. Further epidemiological studies on adult acne in both sexes may illuminate the pathogenesis of the disease, thus making possible the development of new treatment strategies.

Keywords: adult acne, late-onset acne, recurrent acne, epidemiology, triggering factors

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Introduction

Acne vulgaris (AV) is a chronic, inflammatory disease of the pilosebaceous unit. Although acne predominantly affects adolescents, it may also affect adults (1). Adult acne or acne tarda refers to acne diagnosed over the age of 25 years. Although most studies have investigated two types of adult acne, including persistent and late-onset acne, recently it has been suggested that three types exist: persistent, late-onset, and recurrent acne (2, 3). Persistent acne begins in adolescence and continues into adulthood. Late-onset acne is the type of acne that begins in adulthood. Finally, recurrent acne is the form that begins in adolescence and is characterized by a relapse in adulthood after an acne-free period without the use of any medication (1–3).

Although evidence about some of these types is controversial, many triggering factors of adult acne have been documented so far. In this regard, internal factors such as high body mass index, hormonal imbalance, and genetic factors have been proposed to cause the occurrence or aggravation of acne. On the other hand, stress, smoking, using cosmetic products, and oral contraceptives

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have been postulated as external factors (3, 4). Recent studies have also focused on the effect of dietary factors on the pathogenesis of acne (5, 6).

Although there are numerous studies in the literature on the epidemiological characteristics of adolescent acne, studies focusing on adult acne are quite limited. Moreover, the main studies on adult acne mostly focus on females, probably because they have a higher incidence (7). Therefore, adult male acne is not well known yet. In addition, most studies do not compare characteristics between the different types of adult acne. To the best of our knowledge, this is the first large-scale study regarding adult acne that includes three different types of acne.

This study describes the epidemiological factors of adult acne and investigates certain involvement areas and triggering factors by sex in three types of adult acne.

Methods

This multicenter, prospective, descriptive study was conducted at secondary and tertiary care hospitals in seven regions of Turkey between January 2020 and August 2021. The study group included patients with acne between 25 and 65 years old that were admitted to dermatology outpatient clinics for any skin condition. The control group included patients admitted to a dermatology outpatient clinic for dermatologic conditions (insect bite, cosmetic procedure, warts, etc.) other than acne and inflammatory dermatologic diseases.

A standardized questionnaire was designed, and sociodemographic features (age, sex, and anthropometric measures including height and weight), medical history, age of onset and duration of acne, type of acne, family history, and triggering and prognostic factors were recorded. The patients with acne and those in the control group were compared with each other in terms of medical history, family history, smoking, alcohol use, and dietary factors.

Acne localization was classified into three categories: U-zone (cheeks, perioral, and lower chin area), T-zone (forehead, nose, and upper chin area), and mixed zone (areas of both the U-zone and T-zone). The study aimed to investigate the triggering and prognostic factors of acne, as well as previous treatments, in relation to sex and different types of acne.

The characteristics of menstruation, including age at menarche, use of oral contraceptive pills, average length of menstrual cycle, and number of menstrual periods during the past 12 months, were recorded for female patients. Hirsutism was evaluated using the modified Ferriman–Gallwey (mFG) score. A total mFG score of ≥ 8 was considered hirsutism based on the Society of Endocrinology and Metabolism of Turkey Guideline (8).

The diagnosis of polycystic ovarian syndrome (PCOS) was made according to the 2003 Rotterdam criteria by an obstetrician-gynecologist. The diagnostic criteria included i) presence of oligomenorrhea or amenorrhea, ii) clinical and/or biochemical hyperandrogenism, and iii) polycystic ovaries on ultrasonography (9).

A food frequency questionnaire was used to record information on the intake of selected food items, including usual number of portions per week during the week before the interview. Food frequency questionnaires and portion size were obtained from previous studies to provide standardization (10, 11). The selected food items were potatoes, white bread, white rice, white sugar, processed fruit juice (1 cup or a 200 ml small package), banana (ripe), watermelon, crackers, corn chips (25 grams per serving), cornflakes, cake (one slice), whole-grain bread, hazelnut (1 cup per serving), chocolate (about 40 grams per serving), brown rice, sugarcane, rye bread, ice cream (three scoops per serving), oatmeal cookies (six per serving), honey (1 tablespoon per serving), chickpeas (1 cup per serving), dry beans (1 cup per serving), lentil soup, apple (one per serving), oranges (one piece, one serving), pasta, whole-wheat bread, milk (1 cup per serving), cheese (one piece the size of a matchbox per serving), fish, and red meat (1 tablespoon). The association between the frequency of consumption of food in the acne and control groups was examined.

Smoking habit and alcohol consumption were also investigated. The average daily consumption of alcohol was computed assuming the following pure alcohol content in each type of drink: 150 ml of wine = 330 ml of beer = 30 ml of spirits = 10 to 12 g of pure alcohol. Patients that had a period of abstinence from cigarettes and alcohol for at least 6 months before the date of diagnosis were classified and recorded as ex-smokers or ex-drinkers.

The severity of acne was classified into five categories according to the Comprehensive Acne Severity Scale (12).

Ethical approval for the study was obtained from the Van Yüzüncü Yıl University Non-Interventional Clinical Research Ethics Committee (May 25th, 2021). The study data were analyzed with the SPSS IBM 22.0 package data program. Descriptive statistics such as frequencies, mean and standard deviation, and percentage calculations were made using demographic data. The normality test of continuous measurements was performed with the Shapiro–Wilk test. Paired group comparisons of normally distributed data were made using a *t*-test, and paired group comparisons of non-normally-distributed data were made using the Mann–Whitney *U* test. Comparisons of two or more groups of qualitative data were performed with the chi-square test. The odds ratio (OR) was obtained to quantify the strength of the association between groups. The variation and association between two measurements were tested with correlation analysis. Logistic regression analysis was performed to examine the effects of consumed foods on the acne and control groups. Statistical analyses were performed at the 95% confidence level (i.e., with a 5% margin of error), and $p < 0.05$ was considered statistically significant.

Results

Study population

A total of 1,066 (56.62%) patients with acne and 960 (52.62%) patients with non-inflammatory dermatological diseases were included in this study. There were 944 (88.56%) females and 122 (11.44%) males in the acne group, and 709 (73.85%) females and 251 (26.15%) males in the control group. In the acne group, 94.6% of the females were in the premenopausal period and 4.3% in the postmenopausal period.

Body mass index

The mean age and body mass index (BMI) of the patients in the acne group were 30 ± 5 years and 23.5 ± 4.3 kg/m², and they were 32.3 ± 7.8 years and 24.9 ± 4.3 kg/m² in the control group ($p < 0.001$). All three adult acne subtypes were compared regarding mean BMI, and no statistically significant differences were found ($p = 0.277$). The mean BMI value was 23.28 ± 3.96 in the persistent acne group, 23.22 ± 3.60 in the recurrent group, and 23.91 ± 4.45 in the late-onset acne group.

Past medical history

Diseases affecting the sebaceous glands other than acne, such as pilonidal sinus, hidradenitis suppurativa, and dissecting cellulitis, were statistically significantly higher in the acne group (2.2%) than in the control group (0%; $p = 0.002$). The most common sebaceous gland disease in the acne group was the presence of pilonidal sinus (1.13%), followed by hidradenitis suppurativa (0.66%) and dissecting cellulitis (0.38%). There was no statistically significant difference in the frequency of diseases affecting the sebaceous glands apart from acne between females (0.25%) and males (3.5%; $p = 0.334$).

Family history

The frequency of first-degree relatives affected by sebaceous gland diseases was significantly higher in the acne group (50.52%) than in the control group (21.24%; $p < 0.001$). A history of severe acne in the family was significantly higher in the acne group (27.72%) than in the control group (8.03%; $p < 0.001$). Patients with mild or moderate acne less commonly had a history of acne in the family (48.07%) when compared to patients with severe or very severe acne (59.66%; $p = 0.004$).

Smoking and drinking habits

The smoking rate was 24.5% in the acne group and 23.6% in the control group. There was no statistically significant difference between the two groups in terms of smoking ($p = 0.247$). There was no statistically significant difference between the frequency of alcohol consumption in the acne (8.90%) and control groups (8.22%; $p = 0.639$).

Dietary factors

Considering foods separately, consumption of crackers, chocolate, and pasta was statistically significantly higher in the acne group when compared to the control group ($p = 0.002$, $p = 0.005$, $p = 0.039$, respectively). Consumption of three or more servings of crackers per week occurred in 2.72% of the acne group and in 0.83% of the control group (OR: 3.33, 1.51–7.03). Consumption of three or more servings of chocolate per week occurred in 18.28% of the acne group and in 13.72% of the control group (OR: 1.41, 1.1–1.79). Consumption of three or more servings of pasta per week occurred in 3.75% of the acne group and in 2.18% of the control group (OR: 1.75, 1.02–2.98).

Using logistic regression analysis, the consumption of crackers, chocolate, and pasta was significantly more common in the acne group, whereas participants in the acne-free control group were more likely to consume lentils, hazelnuts, oranges, and watermelon, (Table 1). It was found that the consumption of crackers was 3.076 times higher in the acne group ($p = 0.017$, OR: 1.219–7.766), the consumption of chocolate was 1.535 times higher in the acne group ($p = 0.002$, OR: 1.167–2.019), and the consumption of pasta was 1.887 times higher in the acne group ($p = 0.040$, OR: 1.029–3.463). On the other hand, it was found that the consumption of lentils was 0.354 times lower in the acne group ($p = 0.040$, OR: 0.132–0.952), the consumption of hazelnuts was 0.480 times lower in the acne group ($p = 0.001$, OR: 0.308–0.749), the consumption of oranges was 0.822 times lower in the acne group($p = 0.048$, OR: 0.676–0.998), and the consumption of watermelon was 0.681 times lower in the acne group ($p = 0.019$, OR: 0.494–0.938).

Table 1 | **Effect of dietary factors on adult acne based on logistic regression analysis.**

Foods	B	p	OR	OR 95% CI	
				Lower	Upper
Red meat	−0.183	0.469	0.833	0.507	1.367
Crackers	1.124	0.017*	3.076	1.219	7.766
Cornflakes	1.085	0.063	2.961	0.941	9.316
Chocolate	0.428	0.002*	1.535	1.167	2.019
Lentil soup	−1.038	0.040*	0.354	0.132	0.952
Hazelnuts	−0.733	0.001*	0.480	0.308	0.749
Cheese	0.262	0.080	1.299	0.970	1.741
Pasta	0.635	0.040*	1.887	1.029	3.463
Oranges	−0.196	0.048*	0.822	0.676	0.998
Watermelon	−0.385	0.019*	0.681	0.494	0.938

B = unstandardized regression weight, OR = odds ratio, CI = confidence interval.
* statistically significant.

Characteristics of adult acne

Onset and duration of acne

The mean age of onset of acne (in persistent and recurrent groups) was 16.6 ± 9.9 years; 17 ± 10 years in females and 16 ± 11 years in males ($p = 0.186$). On the other hand, the mean age of onset of acne in the late-onset group was 31.21 ± 5.76 years; 31.23 ± 5.76 in females and 30.96 ± 5.95 in males ($p = 0.736$).

The mean duration of current acne was 82.3 ± 89.2 months (80 ± 88 months in females and 101 ± 96 months in males). Males with acne had a statistically significantly longer duration of disease than females ($p = 0.024$).

Types of acne

The most common type of acne was recurrent acne (38.74%) followed by persistent (32.65%) and late-onset acne (28.61%), regardless of sex. Considering sex, the most common type of acne was recurrent acne in females and persistent acne in males. There was a statistically significant difference between males and females in terms of the frequency of acne types ($p < 0.05$; Fig. 1).

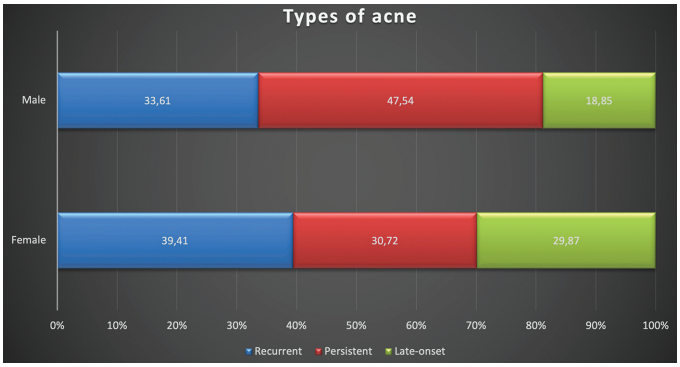

Figure 1 | Frequency of types of acne by sex.

Severity of acne

Altogether, 828 (77.67%) patients had mild or moderate acne, and 238 (22.33%) had severe or very severe acne. There was no statistically significant difference between females and males in terms of acne severity ($p = 0.700$; Table 2).

There was no significant correlation between acne severity and

Table 2 | **Baseline characteristic of participants.**

Acne severity	Both sexes, %	Females, %	Males, %	p
Mild	39.68	39.72	39.34	0.700
Moderate	37.99	38.24	36.07	
Severe	16.69	19.49	21.31	
Very severe	2.63	2.54	3.28	

age (p = 0.101, r = −0.05). There was a statistically significant difference between the three types of acne in terms of acne severity (p = 0.008; Table 3).

Table 3 | **Baseline characteristic of participants.**

Types of acne	Mild or moderate, %	Severe or very severe, %	p
Persistent	71.87	28.13	
Recurrent	79.81	20.19	0.008*
Late-onset	81.92	19.08	

* statistically significant.

Acne localization

As for the involvement sites of acne, the T-zone was involved in 185 patients (17.3%) whereas the U-zone and mixed zone were involved in 332 (31.14%) and 549 (51.50%) patients, respectively. Mixed-zone involvement was the most common site for all types of acne, followed by U-zone and T-zone involvement. There was no statistical difference between the three groups in terms of the frequency of involvement sites (p = 0.654; Fig. 2).

The cheek (59.90%), submandibular area (42.95%), forehead (41.25%), submental area (34.23%), and upper back (32.23%) were the most common involvement sites, regardless of sex. In females the most common site was the the cheek (60.23%), the submandibular area (42.91%), and the forehead (41.25%), and in males the cheek (52.67%), followed by the upper back (40.67%) and the forehead (38%). The perioral (p = 0.003), submandibular (p < 0.001), and submental (p < 0.001) areas were statistically more commonly involved in females than in males, in contrast to the upper (p = 0.016) and lower back (p < 0.001), which were less commonly involved in females than in males.

Triggering and prognostic factors

Altogether, 74.48% of patients stated that at least one certain factor can trigger their acne. Among these factors, the most common one was stress (55.23%), followed by the seasonal effect (27.95%), use of makeup and cosmetics (24.86%), and sleeping disturbance (20.17%). The differences in triggering factors between sexes and among types of acne are explained in Table 4 and Figure 3. The differences in prognostic factors among types of acne are shown in Table 5.

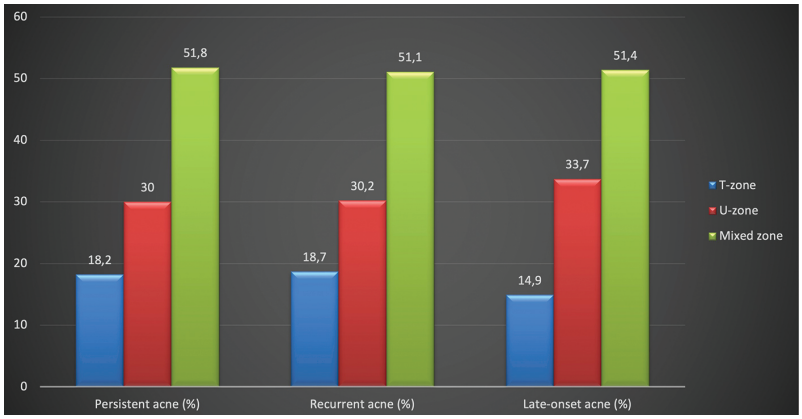

Figure 2 | Involvement zones of acne by types of acne.

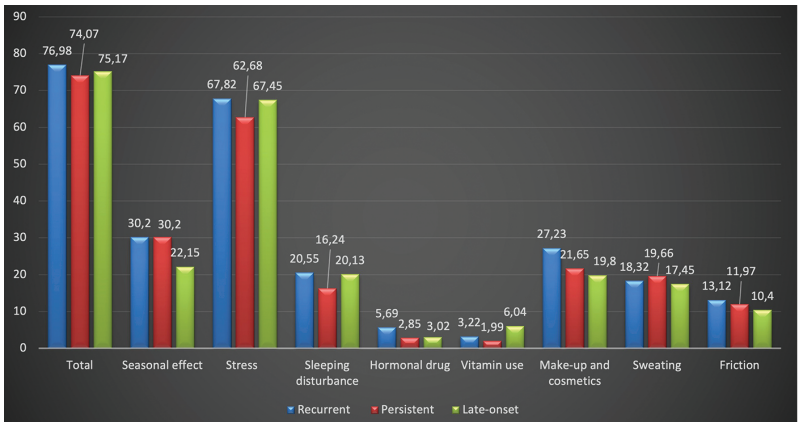

Figure 3 | Frequency of triggering factors by types of acne.

Table 4 | **Differences in triggering factors between sexes and among types of acne.**

Triggering factors	Both sexes, %	Sex, %			Types of acne, %			
		F	M	p	Persistent	Recurrent	Late-onset	p
Total	74.48	61.30	48.45	0.002*	73.86	75.30	73.44	0.643
Seasonal effect	27.95	22.09	24.85	0.492	30.11	29.53	21.64	0.031*
Stress	55.23	55.31	54.66	0.159	62.50	66.34	65.90	0.465
Sleeping disturbance	20.17	16.10	16.77	0.756	16.19	20.10	19.67	0.326
Hormonal drug	4.03	3.34	2.49	0.442	2.84	5.57	2.95	0.087
Vitamin use	3.75	3.17	1.86	0.280	1.99	3.15	5.90	0.023*
Makeup and cosmetics	24.86	21.66	7.45	0.000*	21.60	26.63	19.34	0.050*
Sweating	19.70	15.50	18.01	0.777	19.60	17.92	17.05	0.681
Friction	12.95	10.53	9.32	0.387	11.93	12.83	10.16	0.546

F = female, M = male.
* statistically significant.

Table 5 | **Frequency of certain prognostic factors by types of acne.**

Prognostic factors	Types of acne, %			
	Recurrent	Persistent	Late-onset	*P*-values
Truncal involvement	24.07	26.36	20.07	0.164
Nodulocystic acne	15.88	21.43	18.36	0.147
Hormonal disorders	7.96	10.89	8.85	0.372

The effects of hormonal factors on female acne

The frequency of PCOS in females was 12.56% in the acne group and 4.56% in the control group. The frequency of PCOS was statistically significantly higher in the acne group than in the control group ($p < 0.001$, OR: 3.005). There was a statistically significant difference between acne types in terms of the frequency of PCOS. A total of 14.5% of patients with persistent acne had PCOS, whereas 12.2% of patients with recurrent acne and 11.1% of patients with late-onset acne had PCOS.

The frequency of oral contraceptive use was 10.8% in the acne group, and 3.28% in the control group ($p < 0.001$, OR: 3.56). The mean age of menarche was 13.2 ± 1.21 years in the acne group and 12.9 ± 1.35 years in the control group. The *p*-value was < 0.001, but the effect size was 0.16. There was no difference between the acne and control groups in terms of menstrual cycle duration ($p = 0.105$). Dysmenorrhea was present in 49.46% in the acne group and 30.94% in the control group. A statistically significant difference was found between two groups in terms of presence of dysmenorrhea ($p < 0.001$, OR: 2.185).

Hyperandrogenism was present in 28.13% of the females with adult acne. Hyperandrogenism symptoms such as seborrhea ($p < 0.001$), androgenetic alopecia ($p < 0.001$), menstrual disorders ($p < 0.001$), galactorrhea ($p = 0.012$), and hirsutism ($p < 0.001$) were statistically significantly higher in the acne group than in the control group.

The mean mFG score was 8 ± 6 in the acne group and 5 ± 4 in the control group. The mFG score was statistically significantly higher in the acne group ($p = 0.001$). There was no significant correlation between mFG score and acne severity ($p = 0.266$; 0.067).

Discussion

Most previous studies divided adult acne into two categories – persistent and late-onset acne. Goulden et al. reported for the first time that persistent acne (73.3%) is more common than adult-onset acne (26.7%). They found the frequency of adult-onset acne to be 8.3% in men and 18.4% in women (13). Other studies described the frequency of late-onset acne as 20% to 40%, and of persistent acne as 60% to 80% (14, 15).

To the best of our knowledge, this is the first study to investigate the frequency of three different types of adult acne in detail, shedding light on various aspects. The most common type of adult acne was the recurrent type (38.74%), followed by persistent (32.65%) and late-onset acne (28.61%), regardless of sex. The prevalence of late-onset acne was compatible with the literature. The frequency of late-onset acne in females (29.87%) was statistically more common than in males (18.85%). Therefore, it can be suggested that hormonal factors may play a role in the pathogenesis of late-onset acne in women.

We also investigated aspects of adult acne in both sexes, including clinical presentation, triggering factors, and other properties, such as hormonal factors, medical history, and previous treatment. The occurrence and severity of acne are affected by both genetic and environmental factors, as in numerous other diseases (16). In our study, we found that the patients in the adult acne group had approximately two times more often a positive family history for acne and three times more often family members with a history of severe acne. Furthermore, we found that patients with more severe acne had a more common family history of acne. Based on these findings, it may be suggested that genetic predisposition contributes to the pathogenesis of adult acne. In concordance with our results, in a large prospective study, the presence of a family history of acne was reported in 59.8% of adult acne patients (17). In addition, Goulden et al. examined 204 acne cases and 144 control volunteers and investigated 1,203 and 856 of their first-degree relatives, respectively. They found that the risk of adult acne emerging in a first-degree relative of a patient with adult acne was significantly greater than for the relative of an unaffected individual (18). The presence of diseases affecting the sebaceous glands other than acne, such as pilonidal sinus, hidradenitis suppurativa, and dissecting cellulitis, may show an individual predisposition for acne (19, 20). In this context, we found that the most common concomitant sebaceous gland disease was pilonidal sinus, followed by hidradenitis suppurativa.

Various studies have highlighted the potential role of smoking in female acne. It was noted that smokers had more frequent and more severe acne than non-smokers. It was also suggested that the non-inflammatory form of acne is related to smoking (21, 22). On the other hand, a recent multicenter study reported that 81% of smokers did not state any association between smoking and the development or exacerbation of acne (17). There are limited studies regarding the effect of alcohol use on acne. In an epidemiology-based study from Korea, half of the subjects stated that exacerbation of their acne occurred after alcohol consumption (23). In contrast to previous studies, we did not find any significant relationship between smoking or drinking alcohol and adult acne. A higher number of males in the control group may have influenced our result because smoking and drinking alcohol was more frequent in males than in females.

An increasing number of studies report compelling evidence that certain diets, such as those with a high glycemic load, may induce the occurrence and aggravation of acne (10, 24, 25). Certain reports have revealed that a high glycemic load is associated with high levels of insulin and IGF-1 and with low levels of sex hormone–binding globulin, which leads to increased sebum production (26). In this regard, it was reported that a low weekly intake of vegetables, fruits, and fish is associated with adult acne (27). Although there are some contradictory results, numerous reports suggest an association between chocolate, white sugar, ice cream, and milk and the presence of acne (10, 11, 28). We found the consumption of foods with a high glycemic index such as crackers, chocolate, and pasta was statistically more common in adult acne patients, which is compatible with previous studies. On the other hand, the consumption of foods with a low glycemic index such as lentil soup and hazelnuts, and fruits such as oranges and watermelon, may have a protective effect against adult acne. The antioxidant and antimicrobial effects of fruits may play an important role in prevention of acne. Further studies are required to elucidate the effect of fruit on acne pathogenesis.

According to our study, the onset of persistent and recurrent acne in both sexes was in late adolescence. The mean age of onset of persistent and recurrent acne was about 17 in females and 16 in males. In concordance with our results, previous studies on adult female acne reported the mean age of onset of persistent acne in Brazil, the United States, and France to be 16.1, 16.3, and

16.6 years, respectively (29). The late-adolescent onset in certain types of adult acne groups may suggest the effect of puberty-related hormonal factors on development because levels of sex-related hormones can increase as age increases (30).

Previous reports revealed that most adult acne patients experience mild to moderate severity of the disease. Tolino et al. reported that the frequency of mild acne was 92% in females and 82% in males with adult acne (31). Similarly, in two different studies, Kaminsky et al. and Han et al. reported that 50% and 75% of adult acne cases were mild, and 46% and 20.2% of adult acne cases were moderate, respectively (16, 32). In line with the literature, we found that mild or moderate acne was more frequent than severe or very severe acne in adults. Although the mild and moderate form of acne is more common, the duration is longer. We also found that severe acne was statistically more common in the persistent form when compared to the other two types. In addition, the frequency of PCOS was the highest in the persistent adult female acne group among all three types, which may point to the reason why severe acne was more common in this type.

It is well documented that adult acne, especially in women, is usually localized on the lower part of the face, which includes the mandibular area. Khunger et al. reported that the most common site of adult acne was the cheek (81%), followed by the chin (67%) and the mandibular area (58.3%) (33). Another epidemiology-based study stated that the most common site of acne involvement was the cheek (85%), followed by the chin (50.6%), forehead (32.8%), and mandibular area (32.8%), in adult patients regardless of sex (34). Apart from these two studies, there are limited studies addressing distribution by sex together with the sites of adult acne because most studies included only female patients. There are a large number of reports showing that adult female acne mainly affects the U-zone, which includes the chin, the mandibular area, and to a lesser degree the perioral region (35–37). There are also a few reports that show adult female acne may also involve truncal sites (30, 36). In concordance with the literature, we found that the most common site of acne was the cheek, followed by the submandibular region, the forehead, the submental region, and upper back areas regardless of sex. In our study, the most common involvement type among all three acne types was mixed-zone involvement. U-zone involvement was the second most common type of involvement, and, although not statistically significant, it was more common in the late-onset group among the three acne types. This result may support the impact of additional hormonal factors on the pathogenesis of late-onset acne in particular. We also found that the submandibular, perioral, and submental areas were statistically more commonly involved in females, whereas the trunk (upper and lower back) was a more commonly involved area in males. With this finding, it can be suggested that there may be differences in the pathogenesis of adult acne in females and males.

Certain triggering factors were described in adult acne. Apart from the aforementioned factors such as genetics, diet, and smoking, it was postulated that stress, sleep disorders, seasonal factors, cosmetics, and hormonal imbalance may also trigger acne (38). Unlike the previous studies, we investigated the role of these triggering factors by sex and types of acne. Stress was stated as the most common factor that trigged acne in our study. The other common factors in females were seasonal effect and using makeup or other cosmetics, whereas in males common factors were seasonal effect and sweating. Based on these results, it can be recommended that males with acne should pay attention to sweating, and females with acne should pay attention to cosmetics use. Sleep disturbance was stated as a triggering factor by about one out of six patients. Certain questionnaire-based studies showed an effect of sleep disturbance on acne (35, 39). Further studies are required to elucidate the contribution of sleep disturbance to acne pathogenesis.

To the best of our knowledge, this is the first study that evaluates triggering factors according to the three types of adult acne. Interestingly, we found remarkable differences in seasonal effect and vitamin use between late-onset acne and other types of acne. Seasonal effect was significantly less frequent in late-onset adult acne, whereas the use of vitamin B12 was significantly more frequent. In the context of these results, vitamin B12 use should be questioned in particular in association with late-onset acne. The reason for less frequent seasonal effect in late-onset acne, when compared to other types, should be investigated with further studies. In addition, we found that one of the important triggering factors in patients with recurrent acne was makeup and cosmetics. Therefore, patients with recurrent acne can be questioned about use of makeup and cosmetics.

Recent evidence suggests that certain hormones induce adult female acne. A small percentage of adult females with acne have symptoms of hyperandrogenism (40). These symptoms, including seborrhea, androgenetic alopecia, galactorrhea, menstrual cycle disturbances, late menarche age, and hirsutism, may indicate underlying endocrine disorders such as PCOS, adrenal hyperplasia, or adrenal gland tumors (9). Goulden et al. reported that 37% of females with adult acne have at least one symptom of hyperandrogenism. They also reported that 17.7% of patients with persistent acne and 14.3% with late-onset acne have a menstrual irregularity (13). Herein, consistent with previous studies, we found significantly more common symptoms of hyperandrogenism in patients with adult acne when compared to the acne-free control group. Hyperandrogenism was present in 28.13% of females with acne. Although hirsutism was more common in female adult acne, we did not find any correlation between mFG score and acne severity. The presence of PCOS in female adult acne is one of the reasons for symptoms of hyperandrogenism, including hirsutism. Considering the highest percentage of PCOS in persistent acne, the most severe form is the persistent acne type. Finally, we found that the use of oral contraceptive drugs was three times more common in females with adult acne than in other females. There may be two explanations for this. First, the main reason for the use of oral contraceptives may be PCOS in female patients with adult acne because oral contraceptive drugs are one of the mainstay treatments for PCOS. Second, the use of androgen and progesterone-derived oral contraceptives can lead to the occurrence and aggravation of acne. Thus, females with persistent acne should be questioned about the presence of PCOS and use of oral contraceptive drugs and their ingredients (41). It is noteworthy that the use of oral contraceptives, including a combination of ethinylestradiol and cyproterone acetate (androgen receptor blockers), is recommended for mild to moderate adult female acne.

The chief limitation of our study is that the laboratory results, in particular the hormonal parameters, were not included in this report. In addition, the fact that some results were based on patients' statements may have increased the possibility of bias. Finally, female predominance in the acne group is another limitation of this study, and therefore data on male patients with adult acne are limited.

In conclusion, according to our study, although adult females

and males share similar triggering factors, the involvement areas can differ from each other, which may indicate an additional hormonal effect of adult female acne. Dietary factors and family history may play an important role in adult acne in both sexes. It seems that the most common type of adult acne is the recurrent type, whereas persistent acne is the most severe form of adult acne. Compared to the other types, persistent acne is mostly seen in female patients with PCOS. Further epidemiology-based studies may shed light on the pathogenesis of adult acne in both males and females.

References

1. Williams HC, Dellavalle RP, Garner S. Acne vulgaris. Lancet. 2012;379:361–72.
2. Dreno B, Bagatin E, Blume-Peytavi U, Rocha M, Gollnick H. Female type of adult acne: physiological and psychological considerations and management. J Dtsch Dermatol Ges. 2018;16:1185–94.
3. Bagatin E, Freitas THP, Rivitti-Machado MC, Machado MCR, Ribeiro BM, Nunes S, et al. Adult female acne: a guide to clinical practice. An Bras Dermatol. 2019;94: 62–75.
4. Moradi Tuchayi S, Makrantonaki E, Ganceviciene R, Dessinioti C, Feldman SR, Zouboulis CC. Acne vulgaris. Nat Rev Dis Primers. 2015;1:15029.
5. Melnik BC, Zouboulis CC. Potential role of FoxO1 and mTORC1 in the pathogenesis of Western diet-induced acne. Exp Dermatol. 2013;22:311–5.
6. Penso L, Touvier M, Deschasaux M, Hercberg S, Ezzedine K, Sbidian E. Association between adult acne and dietary behaviors: findings from the NutriNet-Santé Prospective Cohort Study. JAMA Dermatol. 2020;156:854–62.
7. Dréno B, Layton A, Zouboulis C, López-Estebaranz JL, Zalewska-Janowska A, Bagatin E, et al. Adult female acne: a new paradigm. J Eur Acad Dermatol Venereol. 2013;27:1063–70.
8. Türkiye Endokrinoloji ve Metabolizma Derneği. Obesity, lipid metabolism, hypertension study group diagnosis and treatment guide [Internet]. 2019 [cited 2022 Aug 20]. Available from: https://file.temd.org.tr/Uploads/publications/guides/documents/20190506163904-2019tbl_kilavuz5ccdcb9e5d.pdf. Turkish.
9. Rotterdam ESHRE/ASRM-Sponsored PCOS Consensus Workshop Group. Revised 2003 consensus on diagnostic criteria and long-term health risks related to polycystic ovary syndrome. Fertil Steril. 2004;81:19–25.
10. Kutlu Ö, Balta İ, Ekşioğlu HM. Determination of the effect of diet on the development and severity of acne vulgaris by using insulin index and glycemic index. Turkiye Klinikleri J Dermatol. 2020;30:6–14.
11. 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. G Ital Dermatol Venereol. 2019; 154:177–85.
12. Tan JKL, Tang J, Fung K, Gupta AK, Thomas DR, Sapra S, et al. Development and validation of a comprehensive acne severity scale. J Cutan Med Surg. 2007;11: 211–6.
13. Goulden V, Clark SM, Cunliffe WJ. Post-adolescent acne: a review of clinical features. Br J Dermatol. 1997;136:66–70.
14. Holzmann R, Shakery K. Postadolescent acne in females. Skin Pharmacol Physiol. 2014;27 Suppl 1:3–8.
15. Dumont-Wallon G, Dréno B. Specificity of acne in women older than 25 years. Presse Med. 2008;37:585–91.
16. George RM, Sridharan R. Factors aggravating or precipitating acne in Indian adults: a hospital-based study of 110 cases. Indian J Dermatol. 2018;63:328–31.
17. Kaminsky A, Florez-White M, Bagatin E, Arias MI; Iberian Latin American Acne Studies Group (GILEA – Grupo Ibero-Latinoamericano de Estudio del Acne). Large prospective study on adult acne in Latin America and the Iberian Peninsula: risk factors, demographics, and clinical characteristics. Int J Dermatol. 2019;58:1277–82.
18. Goulden V, McGeown CH, Cunliffe WJ. The familial risk of adult acne: a comparison between first-degree relatives of affected and unaffected individuals. Br J Dermatol. 1999;141:297–300.
19. Jansen T, Plewig G. Acne inversa. Int J Dermatol. 1998;37:96–100.
20. Wollina U, Koch A, Heinig B, Kittner T, Nowak A. Acne inversa (hidradenitis suppurativa): a review with a focus on pathogenesis and treatment. Indian Dermatol Online J. 2013;4:2–11.
21. Capitanio B, Sinagra JL, Bordignon V, Cordiali Fei P, Picardo M, Zouboulis CC. Underestimated clinical features of postadolescent acne. J Am Acad Dermatol. 2010;63:782–8.
22. Capitanio B, Sinagra JL, Ottaviani M, Bordignon V, Amantea A, Picardo M. Acne and smoking. Dermatoendocrinol. 2009;1:129–35.
23. Suh DH, Kim BY, Min SU, Lee DH, Yoon MY, Kim NI, et al. A multicenter epidemiological study of acne vulgaris in Korea. Int J Dermatol. 2011;50:673–81.
24. Conforti C, Agozzino M, Emendato G, Fai A, Fichera F, Marangi GF, et al. Acne and diet: a review. Int J Dermatol. 2022;61:930–4.
25. Marson J, Baldwin HE. Acne, twins, and glycemic index: a sweet pilot study of diet and dietary beliefs. J Am Acad Dermatol. 2020;83:AB110.
26. Melnik BC, John SM, Plewig G. Acne: risk indicator for increased body mass index and insulin resistance. Acta Derm Venereol. 2013;93:644–9.
27. Di Landro A, Cazzaniga S, Cusano F, Bonci A, Carla C, Musumeci ML, et al. Adult female acne and associated risk factors: results of a multicenter case-control study in Italy. J Am Acad Dermatol. 2016;75:1134–41.e1.
28. 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: 2244–53.
29. Preneau S, Dreno B. Female acne—a different subtype of teenager acne? J Eur Acad Dermatol Venereol. 2012; 26:277–82.
30. Delemarre-van de Waal HA, van Coeverden SC, Rotteveel J. Hormonal determinants of pubertal growth. J Pediatr Endocrinol Metab. 2001;14 Suppl 6:1521–6.
31. Skroza N, Tolino E, Mambrin A, Zuber S, Balduzzi V, Marchesiello A, et al. Adult acne versus adolescent acne: a retrospective study of 1,167 patients. J Clin Aesthet Dermatol. 2018;11:21–5.
32. Han XD, Oon HH, Goh CL. Epidemiology of post-adolescence acne and adolescence acne in Singapore: a 10-year retrospective and comparative study. J Eur Acad Dermatol Venereol. 2016;30:1790–3.
33. Khunger N, Kumar C. A clinico-epidemiological study of adult acne: is it different from adolescent acne? Indian J Dermatol Venereol Leprol. 2012;78:335–41.
34. Shah N, Shukla R, Chaudhari P, Patil S, Patil A, Nadkarni N, et al. Prevalence of acne vulgaris and its clinico-epidemiological pattern in adult patients: results of a prospective, observational study. J Cosmet Dermatol. 2021; 20:3672–8.
35. Poli F, Dreno B, Verschoore M. An epidemiological study of acne in female adults: results of a survey conducted in France. J Eur Acad Dermatol Venereol. 2001;15:541–5.
36. Schmitt JV, Masuda PY, Miot HA. Padrões clínicos de acne em mulheres de diferentes faixas etárias. An Bras Dermatol. 2009;84:349–54. Portuguese.
37. Rivera R, Guerra A. Manejo del acné en mujeres mayores de 25 años. Actas Dermosifiliogr. 2009;100:33–7. Spanish.
38. Dréno B, Thiboutot D, Layton AM, Berson D, Perez M, Kang S. Large-scale international study enhances understanding of an emerging acne population: adult females. J Eur Acad Dermatol Venereol. 2015;29:1096–106.
39. Schrom KP, Ahsanuddin S, Baechtold M, Tripathi R, Ramser A, Baron E. Acne severity and sleep quality in adults. Clocks Sleep. 2019;1:510–6.
40. Sjaarda LA, Mumford SL, Kissell K, Schliep KC, Hammoud AO, Perkins NJ, et al. Increased androgen, anti-Müllerian hormone, and sporadic anovulation in healthy, eumenorrheic women: a mild PCOS-like phenotype? J Clin Endocrinol Metab. 2014;99:2208–16.
41. 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:S1–37.