Prevalence, Severity, and Severity Risk Factors of Acne in High School Pupils: A Community-Based Study

S. Zahra Ghodsi[1], Helmut Orawa[2] and Christos C. Zouboulis[3,4]

A cross-sectional, community-based study was performed to determine the prevalence and severity of acne vulgaris in adolescents and of factors influencing the acne severity risk. The presence of acne was clinically determined and the secondary outcome measures of family acne history and the relation of acne to nutrition habits, emotional stress, menstruation, and smoking were recorded in a questionnaire. A representative sample of 1,002 pupils aged 16 ± 0.9 years was enrolled. The overall acne prevalence was 93.3, 94.4% for boys and 92.0% for girls. Moderate to severe acne was observed in 14%. The prevalence of moderate to severe acne was 19.9% in pupils with and 9.8% in those without a family history of acne ($P<0.0005$; OR: 2.3). Acne severity risk increased with the number of family members with acne history. A mother with acne history influenced the severity of acne the most. Increasing pubertal age, seborrhea, the premenstrual phase, mental stress, and sweet and oily foods were recognized as risk factors for moderate to severe acne. In contrast, gender, spicy foods, and smoking were not associated with acne severity. In conclusion, acne is a common disorder in Iranian adolescents, with a low rate of moderate to severe acne. A genetic background is suggested, with mother's acne history being the most important prognostic factor. Skin quality and certain nutrition habits may affect acne severity.

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INTRODUCTION

Acne vulgaris is one of the most common skin diseases, usually beginning in adolescence and often resolving spontaneously once adulthood is reached. Therefore, large-scale epidemiological studies on acne vulgaris have to be focused mainly on adolescents.

Data of population-based epidemiologic studies are important in quantifying disabilities, use, and cost of health services. They can also be used as a guide to find out whether there is a need for specific education of those affected and for health providers offering care for them. Despite these facts, data based on community-based samples including an actual dermatological examination of acne patients are scarce.

This work reports the prevalence and severity of acne and the detection of acne severity risk factors in a representative sample of high school pupils in Tehran, Iran, whereas all of them have been dermatologically examined. To date, few similar studies have been reported in the literature (Freyre *et al.*, 1998; Kilkenny *et al.*, 1998; Smithard *et al.*, 2001; Yeung *et al.*, 2002; Purvis *et al.*, 2004; Amado *et al.*, 2006; Nijsten *et al.*, 2007; Table 1).

RESULTS

The 1,002 pupils enrolled were 499 boys (49.8%) and 503 girls (50.2%) aged between 12 and 20 years (mean ± SD 16 ± 0.9 years). The overall prevalence of acne was 93.2% (95% confidence intervals (CI) 91.5–94.7%), 94.4% for boys and 92.0% for girls. Here, 68 pupils (6.8%) were rated by the examiners as having no acne, 793 (79.1%) as having mild acne, and 140 (14.0%) as having moderate to severe acne.

No association between gender and acne severity was assessed. The mean age of the pupils with moderate/severe acne (16.3 years) was significantly higher than that of individuals with no/mild acne (15.7 years; $P=0.006$). 66 of the 320 pupils ⩾17 years old presented with moderate/severe acne (20.6%) compared with 72 of 673 pupils (10.7%) aged ⩽16 years ($P<0.0005$; odds ratio (OR) = 2.2, 95% CI 1.5–3.1; χ^2 test).

[1]*Department of Dermatology, Tehran University of Medical Sciences, Tehran, Iran;* [2]*Department of Biostatistics and Data Management, Coordination Center for Clinical Studies, Charité Universitaetsmedizin Berlin, Campus Virchow Klinikum, Berlin, Germany;* [3]*Departments of Dermatology, Venereology, Allergology and Immunology, Dessau Medical Center, Dessau, Germany and* [4]*Laboratory of Biogerontology, Dermato-Pharmacology and Dermato-Endocrinology, Institute of Clinical Pharmacology and Toxicology, Charité Universitaetsmedizin Berlin, Campus Benjamin Franklin, Berlin, Germany*

Correspondence: Professor Christos C. Zouboulis, Departments of Dermatology, Venereology, Allergology and Immunology, Dessau Medical Center, Auenweg 38, Dessau 06847, Germany.
E-mail: christos.zouboulis@klinikum-dessau.de

Abbreviations: CI, confidence interval(s); MLR, multivariate logistic regression; OR, odds ratio; ULR, univariate logistic regression

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Pupils with a family history of acne exhibited a higher prevalence of moderate/severe acne (19.9%) than those with no family history (9.8%), ($P=0.0017$; OR = 1.7, 95% CI 1.1–2.6; multivariate logistic regression (MLR)). According to the family history of acne, the pupils were classified into 3 groups: no family history (parents and brothers/sisters), history in one family member, and history in two or more family members. The higher the number of affected family members was, the higher was the risk of suffering from moderate/severe acne ($P<0.0005$; univariate logistic regression (ULR)). The most significant family member with acne history influencing acne prevalence of the pupils examined was the mother ($P<0.0005$; OR = 2.8; 95% CI 1.8–4.5; ULR), followed by the father ($P=0.041$; OR = 1.9; 95% CI 1.0–3.5; ULR), whose acne history was more important than such history in sisters or brothers.

Skin type was associated with the severity grade of acne, whereas moderate/severe acne occurred more often in high school pupils with seborrheic than with normal skin ($P<0.0005$; OR = 2.8; 95% CI 1.7–4.5; MLR). Similar results were obtained by the patient's self-evaluation of his/her skin greasiness ($P<0.0005$; OR = 2.6; 95% CI 1.6–4.2; MLR). The premenstrual phase in female high school pupils and mental stress were positively associated with the severity grade of acne ($P=0.015$ and $P<0.0005$, respectively; χ^2 test). Smoking did not correlate with acne severity. However, of the six female smokers, three (50%) exhibited moderate/severe acne, which is a higher rate than in non-smokers (61/471, 13.0%; $P=0.008$; OR = 6.7, 95% CI 1.3–34.1; χ^2 test). In male pupils, the rate of those with moderate/severe acne was similar in smokers (7/47, 14.9%) and non-smokers (66/448, 14.7%).

Certain high school pupils' nutrition habits, such as regular eating of sweets ($P<0.0005$; MLR), nuts, chocolates, and oily foods, were associated with increased acne severity ($P<0.0005$, $P=0.03$, and $P=0.02$, respectively; χ^2 test). No such correlation was detected for spicy foods or fasting.

The results of the correlation of the secondary outcome criteria with acne severity are shown in Table 2. The type of skin according to patient's evaluation was the strongest parameter associated with acne severity in the MLR, followed by regular eating of sweet foods, type of skin according to physician's evaluation, and family history of acne.

DISCUSSION

Our community-based study of Tehran high school pupils confirms that acne is a very common disorder in adolescents and mirrors the global significance of the disease (Table 1). In particular, moderate to severe acne, which requires systemic treatment (Gollnick *et al.*, 2003) and may have a considerable emotional impact, exhibits a high prevalence seen in Iranian pupils less commonly (14%) compared with other populations reported (Freyre *et al.*, 1998; Kilkenny *et al.*, 1998; Smithard *et al.*, 2001; Yeung *et al.*, 2002; Purvis *et al.*, 2004; Amado *et al.*, 2006; Nijsten *et al.*, 2007).

The prevalence of acne in different studies varies partly depending on the method of classification. A disturbing factor is the fact that there is no internationally agreed uniform system for acne classification. In this work, we evaluated our patients by counting the lesions (comedones, papules, pustules, cysts, nodules, and scars) but performed the analysis after applying the Global Alliance to Improve Outcomes in Acne classification to ameliorate inter-observer variations and to make the data relevant for future studies. Our prevalence data do not differ from those of the few community-based studies reported earlier (Kilkenny *et al.*, 1998; Yeung *et al.*, 2002; Amado *et al.*, 2006; Nijsten *et al.*, 2007), and which range from 82.1 to 94.9%, while the New Zealand study was not based on a clinical examination of the study population but on a questionnaire only (Purvis *et al.*, 2004), and the UK study was a single school one (Smithard *et al.*, 2001). On the other hand, variations of acne prevalence in community-based studies with a subsequent clinical examination may be related to frankly studied differences between populations, which can be due to genetic and/or environmental factors. The low acne prevalence in Peruvian adolescents (Freyre *et al.*, 1998) may be explained by the findings of Cordain *et al.* (2002) on acne in South Americans, whereas the role of nutrition or genetics for these observations remains unclear (Thiboutot and Strauss, 2002). The importance of genetic factors in determining the susceptibility to acne is suggested by genetic and ethnic studies and is confirmed by the very high degree of concordance between identical twins (Friedman, 1984; Bataille *et al.*, 2002; Evans *et al.*, 2005).

In our study, familial history of acne was significantly more common in patients with moderate to severe acne than in patients with mild disease, a finding that is compatible with previous reports (Goulden *et al.*, 1999; Dreno and Poli, 2003; Evans *et al.*, 2005).

On the other hand, the prevalence of moderate to severe acne was higher in pupils with a positive family history than in those with no family history. Therefore, similar to Evans *et al.* (2005), we suggest that a positive family history is associated with higher risk of developing severe acne. Compatible with our findings, Ballanger *et al.* (2006) reported increased rates of retentional lesions and therapeutic difficulties, indicating more severe grades of acne, in patients with a positive family history. In a large twin study with 458 homozygous and 1099 heterozygous twins, 81% (95% CI: 73–87%) of the disease variance could be attributed to genetic causes and only 19% to environmental factors (Bataille *et al.*, 2002).

A new finding of our work is that the most important family member with acne history to increase the risk of developing moderate to severe acne is the mother. Acne history in the father follows, being more important than acne history in older sisters or brothers. These findings clearly indicate a vertical transmission of a genetic risk factor that may be X-chromosome-linked. Moreover, as the number of affected family members increased, the risk for moderate to severe acne in our pupils grew. Ballanger *et al.* (2006) found more severe acne forms in patients with acne history on the mother's side or on both parental sides than in patients with acne history on the father's side only.

Besides these findings, there are also hints that a genetic background can be modified by environmental factors

Table 1. Prevalence of acne vulgaris in adolescent age; review of large studies worldwide

Country	*N*	Prevalence (%)	Moderate to severe (%)	Type of study	Reference
China (Hong Kong)	522	91.3	NR	CB, Q	Yeung *et al.* (2002)
Singapore	1,045	87.9	48.6	CB, Q	Tan *et al.* (2007)
Iran	1,002	93.2	14.0	CB, Q, CE	This study
United Kingdom	317	49.8	21.5	SS, Q, CE	Smithard *et al.* (2001)
Belgium	594	94.9	36.2	CB, Q, CE	Nijsten *et al.* (2007)
Portugal	1,290	82.1	23.8	CB, Q, CE	Amado *et al.* (2006)
Peru	1,857	44.1	19.2	CB, Q, CE	Freyre *et al.* (1998)
New Zealand	9,570	67.3	14.1	CB, Q	Purvis *et al.* (2004)
Australia	666	83.1	20.9	CB, Q, CE	Kilkenny *et al.* (1998)

CB, community-based; CE, clinical examination; NR, not reported; Q, questionnaire; SS=single school.

(Walton *et al.*, 1988; Bataille *et al.*, 2002; Cordain *et al.*, 2002). In the Eskimo population, acne was absent when they were living and eating in their traditional manner, but upon acculturation, acne prevalence became similar to that in Western societies (Cordain *et al.*, 2002). Moreover, among Zulus, acne became a problem only when this population moved from their rural African villages to cities. Acne severity can also be influenced by environmental factors (Walton *et al.*, 1988). The perception that diet is strongly associated with the development of acne and its exacerbation is common and geographically widely distributed, not only among acne patients (Rasmussen and Smith, 1983; Smithard *et al.*, 2001; Tan *et al.*, 2001; Al-Hoquil, 2003; Tallab, 2004). In a study of Green and Sinclair (2001), 41% of final year Australian medical students identified the dietary factors (chocolate, oily and fatty foods, and high sugar content foods) as exacerbating factors in acne. Tehrani pupils were also of the opinion that diet can exacerbate their acne: Nutrition with sweets, nuts, chocolate, and oily foods were considered to significantly increase the severity of acne. In contrast with this high prevalence of belief, there are only a few studies that examined the role of diet in acne. Grant and Anderson (1965) performed trials on chocolate, milk, and roasted nuts in university students and found no effect on acne, but the trials were small, uncontrolled, and had very short follow-up and inadequate statistical analysis. Fulton *et al.* (1969) found no effect of chocolate on acne in a single-blind placebo-controlled cross-over trial in American hospital acne clinic attendees and male prisoners. Evidence showing how diet may directly or indirectly influence the pathogenesis of acne has been provided only currently (Wolf *et al.*, 2004; Adebamowo *et al.*, 2005; Cordain, 2005; Danby, 2005), but the relation between nutrition and acne still needs corroboration.

In our study, there was no association between acne severity and smoking. Some studies have shown cigarette smoking to aggravate acne (Schafer *et al.*, 2001), but others did not confirm this association (Freiman *et al.*, 2004; Firooz *et al.*, 2005) or have even showed a protective effect (Mills *et al.*, 1993; Klaz *et al.*, 2006). The study of Schafer *et al.* (2001) showed acne to be more frequent and severe among smokers, and to follow a dose-dependent association. In contrast, in the study of Klaz *et al.* (2006), active smokers had a significantly lower prevalence of severe acne with an inverse dose-dependent association. This conflicting discrepancy has still to be elucidated.

Gender may have an influence on the relation between acne and smoking. According to Rombouts *et al.* (2007), daily cigarette consumption and duration of smoking appeared to be significantly protective in the development of inflammatory acne in girls. No significant association was detected among boys. In a case–control study, Chuh *et al.* (2004) concluded that smoking is likely to bear a positive correlation with acne for men. Schafer *et al.* (2001) reported a dose-dependent relationship between acne severity and the quantity of cigarettes consumed daily, which was not affected by gender. In our study, severity of smoking or quantity of cigarettes consumed daily was not investigated. The proportion of smoking females who had moderate to severe acne was significantly higher than that of non-smokers. In contrast, no association was found in males. Apart from the low number of female smokers in our study, male pupils may spend many hours a day being together and many of them smoke, whereas the others are passive smokers.

Our female pupils reported premenstrual flare of their acne in 35.5%. Williams and Cunliffe (1973) have stated that acne worsens premenstrually in 60–70% of females. Shaw (2000) reported a 27% rate of premenstrual acne flare in a sample of 85 women. In the study of Stoll *et al.* (2001), 44% of 400 female participants reported premenstrual flares of their acne in the questionnaires. In this survey, compatible with our study, severity of acne did not affect the premenstrual flare rate. Lucky (2004) assessed quantitatively acne lesions over two full menstrual cycles in 25 women and reported a 63% flare rate. Although there is a hypothesis about changes of surface lipid composition in the premenstrual phase, changes in hydration or the molecular structure of keratins (Fisher, 2000) or prostaglandin effects through its vasoactive properties (Tehrani and Dharmallingam, 2004), the exact hormonal cause for this flare is still to be elucidated.

Table 2. Correlation of secondary outcome parameters with acne severity (dependent variable: moderate or severe acne (yes / no))

Independent variable	Analysis method	*P*-value	OR	95% CI
Age ⩾17 years	χ^2 test	<0.0005	2.2	1.5–3.1
Sex	χ^2 test	No association		
Family history of acne[4]	Multivariate log. regression	0.0017	1.7	1.1–2.6
	Univariate log. regression	<0.0005	2.3	1.5–3.4
Number of affected family members	Univariate log. regression	<0.0005		
Mother with acne	Univariate log. regression	<0.0005	2.8	1.8–4.5
Father with acne	Univariate log. regression	0.041	1.9	1.0–3.5
Brother/sister with acne	Univariate log. regression	No association		
Type of skin (patient's evaluation: oily/normal)[1]	Multivariate log. regression	<0.0005	2.6	1.6–4.2
Type of facial skin (physician's assessment: seborrheic/normal)[3]	Multivariate log. regression	<0.0005	2.8	1.7–4.5
Dryness after washing with water	χ^2 test	No association		
Dryness after washing with water and soap	χ^2 test	No association		
Times of washing per week	Univariate log. regression	No association		
Times of washing per day	Univariate log. regression	No association		
Use of emollient creams	χ^2 test	No association		
Hours of sleep	Univariate log. regression	No association		
Hours of exercise per week	Univariate log. regression	No association		
Sweating grade (low/normal/high)	χ^2 test	No association		
Use of cream powder	χ^2 test	No association		
Age of first menstruation	Univariate log. regression	No association		
Regularity of menstruation	Univariate log. regression	No association		
Premenstrual phase (10 days before menstruation)	χ^2 test	0.015		
Mental stress	χ^2 test	<0.0005		
Travel to humid areas	χ^2 test	No association		
Smoking in females	χ^2 test	0.008	6.7	1.3–34.1
Smoking in males	χ^2 test	No association		
Nutrition habits				
Sweets[2]	Multivariate log. regression	<0.0005		
	χ^2 test	<0.0005		
Nuts	χ^2 test	<0.0005		
Chocolate	χ^2 test	0.03		
Oily food	χ^2 test	0.02		
Spicy foods	χ^2 test	No association		
Fasting	χ^2 test	No association		
Seasons of the year	χ^2 test	No association		
Sun exposure	χ^2 test	No association		
Winter skin	χ^2 test	No association		

CI, confidence intervals; log., logistic; OR, odds ratio.
[1–4], the 4 best variables of the multivariate logistic regression of the correlation of secondary outcome parameters with acne severity.

At last, the possible significance of mental stress in acne and the induction of seborrhea has been indicated by previous own experimental studies in tissue and *in vitro* (Zouboulis *et al.*, 2002; Krause *et al.*, 2007; Ganceviciene *et al.*, 2009).

MATERIALS AND METHODS

In this cross-sectional survey, 1,002 high school pupils in Tehran, Iran, were included. The overall target population was all pupils enrolled in high schools in Tehran. The sample was derived by divided, randomly organized steps from the 20 subdivision areas in

the city. The study was granted ethical approval by the Tehran University of Medical Sciences Ethics Committee, adhered to the Declaration of Helsinki guidelines, and has been supported by the university and health service grant.

A detailed procedure for recruitment of schools was undertaken to ensure maximum participation. After permission of the ethical committee of the Iranian ministry of education and coordination with the administrative staff of the schools, the pupils were informed about the study on the examination day. After their oral consent, they received the questionnaire to complete (Table S1).

After the questionnaires were completed, the pupils were examined individually in a room with good natural light. The examination included the face, back, and chest areas in the same sequence for all pupils. The examination team comprised a consultant dermatologist, two residents of dermatology, and two general practitioners. The general practitioners have been trained earlier; dermatology residents and general practitioners worked under the supervision of the consultant dermatologist on their first day of work in the schools.

The examiners counted lesions, including comedones, papules, pustules, cysts, nodules, and acne scars and recorded them on separate sections for the face, back, and chest. In addition, they evaluated the facial skin type as seborrheic, normal, dry, or mixed.

Analysis

To perform the analysis, the acne classification of the Global Alliance to Improve Outcomes in Acne was used (Gollnick *et al*., 2003). According to its criteria, all individuals were classified into three groups: No, mild acne, and moderate/severe acne. Individuals with no and mild acne were included in one group for some evaluations. Individuals with different severity grades in the three body areas examined were classified to the most severe grade detected.

The primary outcomes of the study were the overall acne prevalence and its severity in Tehran high school pupils. The association between clinical acne as the dependent variable and other factors as explanatory variables were analyzed by χ^2 test or logistic regression models. All data were analyzed with the Statistical Package for the Social Sciences, Version 12. Data were presented by OR and 95% CI. Differences were defined as statistically significant at $P<0.05$.

CONFLICT OF INTEREST

The authors state no conflict of interest.

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SUPPLEMENTARY MATERIAL

Table S1. Acne questionnaire of the Tehran Acne Prevalence Study.

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