High Body Mass Index is a Risk Factor for Acne Severity in Adolescents: A Preliminary Report

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ABSTRACT Acne vulgaris is one of the most common chronic dermatological diseases among adolescents. Recent data indicated that a specific diet may affect the course and appearance of acne. The aim of the study was to analyze the relationship between body mass index (BMI) and acne prevalence and severity. This cross-sectional study was conducted among 143 consecutively recruited adolescents aged between 12 and 18. All participants were physically examined, including measurement of weight and height and type and severity of acne. Acne lesions were evaluated as not present (0), mild (1), moderate (2), and severe (3). The predominant type of acne lesions was used to classify the acne into one of the following subtypes: comedonic acne, papulo-pustular acne, and nodulo-cystic acne. Acne was present in 123 adolescents (86.0%) being more prevalent in teenagers ≥15 years old than in those between 12 and 14 years old (97.1% vs. 76.0%, respectively, $P<0.001$). The prevalence of acne did not differ significantly between teenagers with different BMI. However, those teenagers who were overweight or obese suffer from the inflammatory type of acne (papulo-pustular or nodulo-cystic) more often compared with underweight, slim, or normal-weight teenagers ($P=0.03$). The mean BMI value in patients with comedonic acne was significantly lower (mean BMI ± Standard Deviation (SD): 20.0±3.5 kg/m^2) when compared with papulo-pustular acne (22.2±3.8 kg/m^2, $P=0.04$) or nodulo-cystic acne (23.9±5.1 kg/m^2, $P<0.01$). The BMI value correlated significantly with the severity of acne ($\rho=0.33$, $P<0.001$) and with higher number of skin areas involved with acne ($\rho=0.23$, $P<0.01$). Our findings clearly indicate the association between overweight/obesity and acne. Such a relationship has a significant impact on the treatment of patients with acne, as therapy should focus not only on proper selection of medications but also take into account modification of the patient's dietary habits, physical activity, and, if necessary, reduction of body weight.

KEY WORDS: body mass index, acne, child, youth

INTRODUCTION

Acne vulgaris (acne) is one of the most common chronic dermatological diseases among adolescents, affecting about 80% of young people between 12 and 18 years of age (1-3). Despite its high prevalence, the exact pathophysiology of acne remains unknown but is believed to be multifactorial, including genetic predisposition, hormonal disturbances, abnormal hair follicle keratinization, skin colonization by *Priopionibacterium acne*, and disturbances in sebum production (1). Recent findings also support the influence of lifestyle on the disease, indicating that intake of high glycemic index foods may have a profound effect on the development and severity of acne (4). These observations could be of great importance as the number of overweight adolescents continues to increase despite increasing knowledge about risks resulting from obesity (5).

Obesity has become increasingly recognized as a worldwide problem, and the prevalence of childhood obesity is rising rapidly. According to the nutritional status of children in Poland, the prevalence of overweight and obesity among Polish children and teenagers aged 7-18 years was estimated to be 18.8-24.6% for boys and 14.3-17.4% for girls. Compared with European countries, Poland belongs to the group of countries with a moderate to high incidence of overweight and obesity among children and adolescents (6). Consequences of obesity are not only limited to increased risk of cardiovascular diseases, diabetes, and cancer development, but may also include the occurrence or worsening of disorders affecting the skin (7). As mentioned above, a specific diet may affect the course and appearance of acne. Low glycemic index (GI) products have been shown to reduce acne severity (8). Cordain *et al*. (9) reported the absence of acne vulgaris among the Kitavan Islanders of Papua New Guinea and the Ache hunter-gatherers of Paraguay. They attributed this absence to the diet of these groups, which mainly consists of low GI foods (9). In contrast, frequent fat intake (OR=1.39, 95% CI: 1.06-1.82), frequent sugar intake (OR=1.30, 95% CI: 1.05-1.60), frequent consumption of sausages and/or burgers (OR=1.24, 95% CI: 1.03-1.48), and frequent consumption of pastries/cakes (OR=1.20, 95% CI: 1.01-1.43) were shown to be associated with increased risk of acne (10). Additionally, some studies found a positive association between acne and body mass index (BMI) (11,12). Herein we provide further evidence of the link between BMI and acne severity.

PATIENTS AND METHODS

Patients

This cross-sectional study was conducted among 143 consecutively recruited adolescents (58 girls and 85 boys) aged between 12 and 18 years (mean ± Standard Deviation (SD): 14.6±1.5 years) attending one secondary school in the Lower Silesian region (southwest part of Poland). Seventy five (52.4%) schoolchildren were between 12 and 14 years old (group 1) and the remaining 68 (47.6%) were ≥15 years old (group 2). The mean BMI in all participants was 21.6±4.0 (range: 14.5-35.2), and no significant difference was observed between group 1 and 2 regarding BMI values (21.2±4.2 vs 22.0±3.7, *P*=0.34). Based on BMI values, 2.8% of participants (n=4) were classified as underweight, 11.2% (n=16) as slim, 58.7% (n=84) as having normal BMI, 16.8% (n=24) as overweigh, and 10.5% (n=15) as obese.

Study design

After obtaining permission from the parents and patients, all participants were physically examined, including measurement of weight and height and type and severity of acne.

Electronic weight and height scales were used for anthropometric measurements. Patients were measured without shoes and shirts. Height and weight values were used to calculate BMI. According to World Health Organization (WHO) references (13), the BMI value of each pupil was matched to the centile grid, separately for girls and boys, and interpreted as follows: underweight: BMI <5 centile, slim: BMI between 5 and 25, normal weight: ≥25 up to 85 centile, overweight: ≥85 but less than 95 centile, and obesity: ≥95 centile.

The diagnosis of acne was based on the presence of open and closed comedones, papules and pustules, cysts, and nodules in the typical acne localizations: the face, shoulders/back, anterior chest, and arms (14). During physical examination, acne lesions were evaluated as not present (0), mild (1), moderate (2), and severe (3). The predominant type of acne lesions was used to classify the acne into one of the following subtypes: comedonic acne, papulo-pustular acne, and nodulo-cystic acne. In addition, parents were asked to complete a short survey on their past history of acne and dietary habits.

Statistical analysis

All data were statistically analyzed with Statistica 12.5 (Statsoft, Kraków, Poland). Mean, minimal, and maximal values as well as standard deviations and frequencies were calculated. Students T test, χ^2 with Yates correction, and analysis of variance (ANOVA) with Scheffé post hoc test were used when necessary to compare the studied groups of patients. Spearman rank correlation test was used to detect significant correlations between analyzed variables. *P* values lower than 0.05 were considered significant.

RESULTS

Prevalence and severity of acne

Acne was present in 123 adolescents (86.0%), being more prevalent in teenagers ≥15 years old than in those between 12 and 14 years old (97.1% vs. 76.0%, respectively, *P*<0.001). All patients with acne had skin lesions on the face; the shoulders/back (n=64, 52.0%) were the second most common location of acne, followed by the anterior chest area (n=30, 24.4%) and arms (n=25, 20.3%). Teenagers in group 2 (15-18 years old) had slightly acne lesions located more often on

the shoulders/back (60.6%) than those from group 1 (42.1%, p=0.06), while acne lesions in other areas were found with similar frequency in both groups (group 1: anterior chest: 21.1%, arms: 19.3%; group 2: anterior chest: 27.3%, arms: 21.2%, *P*=0.55 and *P*=0.97, respectively). Regarding the family history of acne, 34.3% mothers and 27.8% fathers of examined teenagers reported that they had suffered from acne in the past.

The severity of acne was assessed as mild in 48 (39.0%), moderate in 52 (42.3%), and severe in 23 (18.7%) teenagers. Twenty nine (23.6%) subjects had predominantly comedonic acne, 78 (63.4%) had predominantly papulo-pustular acne, and 16 (13.0%) had predominantly nodulo-cystic acne. Both the distribution of the severity as well as the subtype of acne did not differ between younger (group 1) and older (group 2) participants (*P*=0.69 and *P*=0.7, respectively). However, it was observed that girls suffered from severe acne significantly less often compared with boys – girls: 17 (34%) mild acne, 28 (56%) moderate acne, 5 (10%) severe acne; boys: 35 (47.9%) mild acne, 20 (27.4%) moderate acne, 18 (24.7%) severe acne (*P*<0.01). No other significant differences were noted between girls and boys regarding presence of acne (P=0.85), its subtype (*P*=0.12), and localization (*P*=0.22).

Acne prevalence and BMI

The prevalence of acne did not differ significantly between teenagers with different BMI (Table 1). However, those teenagers who were overweight or obese suffered from the inflammatory type of acne (papulo-pustular or nodulo-cystic) more often compared with underweight, slim, or normal-weight teenagers (*P*=0.03) (Table 1). The mean BMI values in patients with comedonic acne was significantly lower (mean BMI: 20.0±3.5 kg/m^2) when compared with papulo-pustular acne (mean BMI: 22.2±3.8 kg/m^2, *P*=0.04) or nodulo-cystic acne (mean BMI: 23.9±5.1 kg/m^2, *P*<0.01). This relationship was observed both in girls (*P*=0.04) as well as in boys (*P*=0.03). Additionally, teenagers with acne located on the shoulders/back had higher mean BMI values (22.9±4.4 kg/m^2, n=64) compared with whose with acne located in other regions (20.9±3.5 kg/m^2, n=59; *P*<0.01). The BMI values

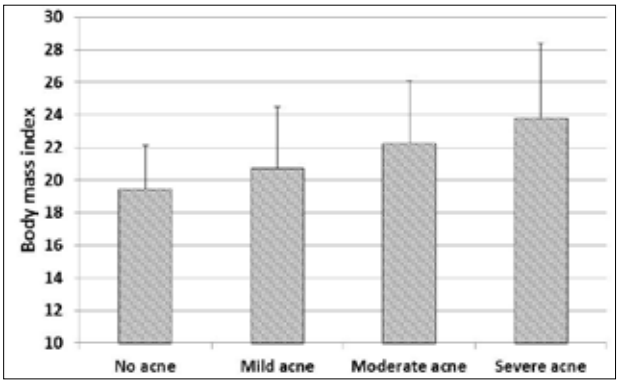

Figure 1. Relationship between acne severity and body mass index (BMI) (ρ=0.33, *P*<0.001) – bars represent mean and standard deviations.

Table 1. Prevalence of acne in comparison with patient weight status

		Underweight N (%)	Slim N (%)	Normal weight N (%)	Overweight N (%)	Obesity N (%)	*P*
All patients	Acne No acne	3 (75.0%) 1 (25.0%)	12 (75.0%) 4 (25.0%)	73 (86.9%) 11 (13.1%)	20 (83.3%) 4 (16.7%)	15 (100.0%) 0 (0.0%)	0.32
	Comedonic acne Papulo-pustular acne Nodulo-cystic acne	2 (66.7%) 0 (0.0%) 1 (33.3%)	6 (50.0%) 5 (41.7%) 1 (8.3%)	18 (24.7%) 48 (65.7%) 7 (9.6%)	2 (10.0%) 15 (75.0%) 3 (15.0%)	1 (6.7%) 10 (66.7%) 4 (26.7%)	0.03
Girls	Acne No acne	- -	5 (83.3%) 1 (16.7%)	32 (86.5%) 5 (13.5%)	9 (81.2%) 2 (18.2%)	4 (100.0%) 0 (0.0%)	0.83
	Comedonic acne Papulo-pustular acne Nodulo-cystic acne	- - -	3 (60.0%) 2 (40.0%) 0 (0.0%)	5 (15.6%) 25 (78.1%) 2 (6.3%)	1 (11.1%) 7 (77.8%) 1 (11.1%)	0 (0.0%) 3 (75.0%) 1 (25.0%)	0.18
Boys	Acne No acne	3 (75.0%) 1 (25.0%)	7 (70.0%) 3 (30.0%)	41(87.2%) 6 (12.8%)	11 (84.6%) 2 (15.4%)	11 (100.0%) 0 (0.0%)	0.36
	Comedonic acne Papulo-pustular acne Nodulo-cystic acne	2 (66.7%) 0 (0.0%) 1 (33.3%)	3 (42.9%) 3 (42.9%) 1 (14.2%)	13 (31.7%) 23 (56.1%) 5 (12.2%)	1 (9.1%) 8 (72.7%) 2 (18.2%)	1 (9.1%) 7 (63.6%) 3 (27.3%)	0.29

also significantly correlated with the severity of acne (ρ=0.33, *P*<0.001) (Figure 1) and with the higher number of skin areas involved with acne (ρ=0.23, *P*<0.01). Both relationships were also observed in subgroups of girls and boys (data not shown).

Dietary habits

Data on dietary habits were obtained from 55 participants (response rate: 38.5%). Based on the answers, 25 (45.5%) of parents reported that their children eat fruits and vegetables every day or almost every day, 19 (34.5%) stated that their children eat them 2-3 times a week, 7 (12.7%) reported at least once a week, and 4 (7.3%) answered that their children do not eat vegetables or fruits at all. Sweets were eaten every day or almost every day by 25 (45.5%) teenagers, 2-3 times a week by 23 (41.8%), at least once weekly by 6 (10.9%) participants, and never by one (1.8%) person. Finally, fast food such as pizza, hot-dogs, chips, etc. were eaten 2-3 times a week by 6 (10.9%), once weekly by 38 (69.1%), and never by 11 (20%) teenagers. None of the above mentioned dietary habits significantly influenced the BMI of included participants. Surprisingly, more prevalent eating of sweets was associated with lower severity of acne (ρ=-0.39, *P*<0.01). No other significant relationships between dietary habits and prevalence, severity, and localization of acne were observed in our group of teenagers.

DISCUSSION

Although we were unable to demonstrate higher prevalence of acne in overweight or obese teenagers, our study clearly indicates that higher BMI in adolescents in Poland is linked with higher risk of more severe acne in comparison with teenagers of normal weight. Furthermore, higher BMI values were also associated with higher prevalence of acne with inflammatory lesions (papules, pustules, nodules, cysts), while non-inflammatory lesions (comedones) were observed more frequently in subjects with lower BMI. Due to the rather small number of analyzed teenagers, our observations must be taken with caution, although the relationship between acne and obesity and dietary habits was also observed by other authors. Ghodsi *et al*. (15) found that acne severity was associated with regular eating of sweets (*P*<0.0005), nuts (*P*<0.005), chocolates (*P*=0.03), and greasy foods (*P*=0.02). Similarly, consumption of chocolates/sweets (OR=1.6) along with overweight or obesity at 18 years of age were significant risk factors for acne (OR=2.7) in a study by Park *et al*. (16). Other authors also indicated a relationship between BMI and acne in different age groups and populations (11,12,17,18). Our observation regarding dietary habits and acne severity are a bit surprising, but they must be considered carefully as they were based only on the parents' reports, who might be unwilling to admit to poor dietary habits in their children. Furthermore, the response rate for the short survey about the dietary habits was low, which further limits the validity of our data.

The mechanism of the influence of obesity on acne is not well understood, but it seems that increased fat content in overweighed/obese patients may facilitate free radical production and lipid peroxidation (19). Some authors emphasized the role of oxidative stress and lipid peroxidation in particular, which may be an early event that helps drive the acne process, indicating the potential role of antioxidants in acne treatment (20,21). Reduction of lipid peroxidation and the decrease of the percentage of oxidized squalene during the acne treatment, in particular, were accompanied with the reduction of hyperkeratinization and inflammatory cells infiltration in the adnexal structures (22,23). High BMI may also result in high level of insulin-like growth factor-1 (IGF-1) (24). IGF-1 stimulates keratinocyte proliferation, sebaceous lipogenesis, and androgen synthesis – all these phenomena may participate in acne development in susceptible individuals (24,25).

CONCLUSION

Our observation clearly indicate an association between overweight/obesity and acne. Such a relationship should have a significant impact on the treatment of patients with acne, and modern approaches to subjects with acne should not only be concentrated on the choice of appropriate therapeutic modality but also have to take into account modification of the patient's dietary habits, physical activity, and, if necessary, reduction of body weight.

References:

1. Tilles G. Acne pathogenesis: history of concepts. Dermatology. 2014;229:1-46.
2. 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(Suppl 1):S1-37.
   Dreno B, Daniel F, Allaert FA, Aubé I. Acne: evolution of the clinical practice and therapeutic management of acne between 1996 and 2000. Eur J Dermatol. 2003;13:166-70.
4. Mahmood SN, Bowe WP. Diet and acne update: carbohydrates emerge as the main culprit. J Drugs Dermatol. 2014;13:428-35.

5. Malczyk E. Nutricial status of children and youth in Poland on basis of literature from last ten years (2005-2015). Ann Acad Med Siles. 2016;70:56-7.
6. Flodmark CE, Lissau I, Moreno LA, Pietrobelli A, Widhalm K. New insights into the field of children and adolescents' obesity: the European perspective. Int J Obes Relat Metab Disord. 2004;28:1189-96.
7. Owczarczyk-Saczonek A, Placek W. Skin lesion and diseases in obesity. Part I: The skin disorders related to insulin resistance and secondary infections. Int Educ Res J. 2016;2:22-6.
8. Smith RN, Mann NJ, Braue A, Mäkeläinen H, Varigos GA. A low-glycemic-load diet improves symptoms in acne vulgaris patients: a randomized controlled trial. Am J Clin Nutr. 2007;86:107-15.
9. Cordain L, Lindeberg S, Hurtado M, Hill K, Eaton SB, Brand-Miller J. Acne vulgaris: a disease of Western civilization. Arch Dermatol. 2002;138:1584-90.
10. Koku Aksu AE, Metintas S, Saracoglu ZN, Gurel G, Sabuncu I, Arikan I, *et al*. Acne: prevalence and relationship with dietary habits in Eskisehir, Turkey. J Eur Acad Dermatol Venereol. 2012;26:1503-9.
11. Tsai MC, Chen W, Cheng YW, Wang CY, Chen GY, Hsu TJ. Higher body mass index is a significant risk factor for acne formation in schoolchildren. Eur J Dermatol. 2006;16:251-3.
12. Di Landro A, Cazza niga S, Parazzini F, Ingordo V, Cusano F, Atzori L, *et al*. Family history, body mass index, selected dietary factors, menstrual history, and risk of moderate to severe acne in adolescents and young adults. J Am Acad Dermatol. 2012;67:1129-35.
13. Available from: http://www.who.int/growthref/who2007_bmi_for_age/en/
14. Pochi PE, Shalita AR, Strauss JS, Webster SB, Cunliffe WJ, Katz HI, *et al*. Report of the consensus conference on acne classification. J Am Acad Dermatol. 1991;24:495-500.
15. 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;129:2136-41.
16. Park SY, Kwon HH, Min S, Yoon JY, Suh DH. Epidemiology and risk factors of childhood acne in Korea: a cross-sectional community based study. Clin Exp Dermatol. 2015;40:844-50.
17. Karciauskiene J, Valiukeviciene S, Gollnick H, Stang A. The prevalence and risk factors of adolescent acne among schoolchildren in Lithuania: a cross-sectional study. J Eur Acad Dermatol Venereol. 2014;28:733-40.
18. Tsai MC, Chen W, Cheng YW, Wang CY, Chen GY, Hsu TJ. Higher body mass index is a significant risk factor for acne formation in schoolchildren. Eur J Dermatol. 2006;16:251-3.
19. Abulnaja KO. Oxidant/antioxidant status in obese adolescent females with acne vulgaris. Indian J Dermatol. 2009;54:36-40.
20. Bowe WP, Patel N, Logan AC. Acne vulgaris: the role of oxidative stress and the potential therapeutic value of local and systemic antioxidants. J Drugs Dermatol. 2012;11:742-6.
21. Al-Shobaili HA, Alzolibani AA, Al Robaee AA, Meki AR, Rasheed Z. Biochemical markers of oxidative and nitrosative stress in acne vulgaris: correlation with disease activity. J Clin Lab Anal. 2013;27:45-52.
22. Capitanio B, Lora V, Ludovici M, Sinagra JL, Ottaviani M, Mastrofrancesco A, *et al*. Modulation of sebum oxidation and interleukin-1α levels associates with clinical improvement of mild comedonal acne. J Eur Acad Dermatol Venereol. 2014;28:1792-7.
23. Tochio T, Tanaka H, Nakata S, Ikeno H. Accumulation of lipid peroxide in the content of comedones may be involved in the progression of comedogenesis and inflammatory changes in comedones. J Cosmet Dermatol. 2009;8:152-8.
24. 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 Histpathol. 2014;36:267-78.
25. Rahaman SMA, De D, Handa S, Pal A, Sachdeva N, Ghosh T, *et al*. Association of insulin-like growth factor (IGF)-1 gene polymorphisms with plasma levels of IGF-1 and acne severity. J Am Acad Dermatol. 2016;75:768-73.