

## Age, Body Mass and Physical Activity Determinants of Facial Acne Severity among Southern Nigerian Adolescents and Young Adults

CC Anyachukwu, OKK Onyeso, CI Ezema

### ABSTRACT

**Objective:** To explore the relationship between severities of acne with age, body mass index (BMI) and physical activity index (PAI) of the patients.

**Methods:** The study employed a cross-sectional design. Acne patients were recruited through quota sampling across Faculties of a University, 120 subjects met the inclusion requirements and gave individual consent; however, only 105 completed the study. A 25 cm<sup>2</sup> quadrant, Global Acne Grading Scale (GAGS), Kaiser Physical Activity Survey (KPAS) and BMI apparatus were used to measure: acne lesion count and density, facial distribution and severity, PAI, and BMI, respectively. Multiple regression, and Spearman's correlation were used for inferential statistical analysis.

**Results:** Subjects' characteristics were: age ( $22 \pm 4$  years), BMI ( $25.3 \pm 3.5$ ), PAI ( $2.5 \pm 0.4$ ) and  $5 \pm 1.7$  acne eruptions per 25 cm<sup>2</sup> of face. Multiple regression showed that age, BMI and PAI significantly predicted acne severity,  $F(3,101) = 4.272$ ,  $p = 0.012$ ,  $R^2 = 0.293$ . Conversely, only age ( $\rho = -0.513$ ,  $p = 0.002$ ,  $CI = 99\%$ ) had a significant (inverse) relationship with acne severity; there is no significant relationship between acne and BMI ( $\rho = 0.034$ ,  $p = 0.846$ ,  $CI = 95\%$ ) or PAI ( $\rho = -0.313$ ,  $p = 0.067$ ,  $CI = 95\%$ ).

**Conclusion:** Age of subjects had a significant correlation with acne severity. However, BMI and PAI had no significant relationship with acne.

**Keywords:** Adolescent, acne vulgaris, body mass index, physical activity index, young adult

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### INTRODUCTION

Acne vulgaris is a common inflammatory disorder of the sebaceous gland (1). It is ubiquitous among adolescents (2); males tend to have more severe disease than females (3). It has been established that age is an important factor in acne eruption (4, 5). The influence of physical activity and body mass indices in acne pathogenesis is previously unrecognized (6). However, the level of physical activity among adolescents is reducing (7), as industrialization encroaches the developing countries (8). Subsequently, obesity in children (9) and adolescents is increasing (10, 11), and may be associated with the increase in prevalence of acne (6, 12). Forty-one

years ago, the prevalence of moderate-severe acne was 10% to 20% in adolescent populations (4). Recently, a survey reported 85% prevalence in a similar population (13). Nonetheless, out of all the dermatology cases, acne accounts for at least 30% of all (14); while 92% of cases are the facial type (15). Usually, acne begins at puberty, when the output of sebum increases substantially (3); it may last for an average of 8-12 years in most patients (5). More often than not, acne improves around 20 years of age, but may linger beyond (16). Moderate intensity exercises (physical activities), body mass and diet (hyperinsulinaemic foods), may represent previously unrecognized environmental and lifestyle factors in the

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development of acne via their influence on androgen-mediated sebum secretion (6, 11).

It was theorized (Fig. 1) that physical activity could alter the acne cascade by lowering the BMI, serum level of androgen and insulin (11), IGF-1 (17), and blood markers of inflammation such as C-reactive protein [CRP] (19) and interleukins [IL] (20). Nonetheless, conventional treatment of acne is by the use of various topical and oral medications (21), but there are major concerns about: bacteria resistance [antimicrobial therapy] (22), long-term side-effect [anti-inflammatory agents], adverse effect [hormone therapy], tetratogenicity [retinoids] (23) and efficacy [phototherapy] (18). Therefore, there is a need to look into other behavioral and lifestyle modifications that can ameliorate acne. This study seeks to determine whether PAI or BMI has any association with the severity of acne among Southern Nigerian adolescents and young adults.

**SUBJECTS AND METHODS**

**Participants**

The study was a cross-sectional research, a proportionate (quota) convenient sampling was used to recruit and screen 180 subjects (thirty each) across the six academic faculties of University of Nigeria, Enugu Campus (UNEC). One hundred and twenty subjects met the

selection criteria, however, 15 subjects later withdrew; therefore 105 participants concluded the study empirical data collection and were analysed.

**Selection inclusion and exclusion criteria**

Subjects were included in the study based on the following criteria: male student of UNEC, apparently healthy, presence of clinically evident facial acne [GAGS severity level rating > 19] (24). Exclusion criteria were: being under any systemic therapy (eg steroids, retinoids or antibiotics) or hyperinsulinaemic diets for at least a month previous to the study, presenting signs of hyperandrogenism, insulin resistance, acne fulminans or follicular occlusion triad, and subjects under stress (students stress scale > 300).

**Procedure of data collection**

The study was conducted in the multipurpose gymnasium (research center) of the Medical Rehabilitation Department, UNEC after the approval of the Health Research Ethics Committee, UNTH. Subjects' parental and informed consent, confidentiality of data, and dignity were ensured and maintained; while the right to withdraw from the study at any stage was ensured throughout the periods of the study.

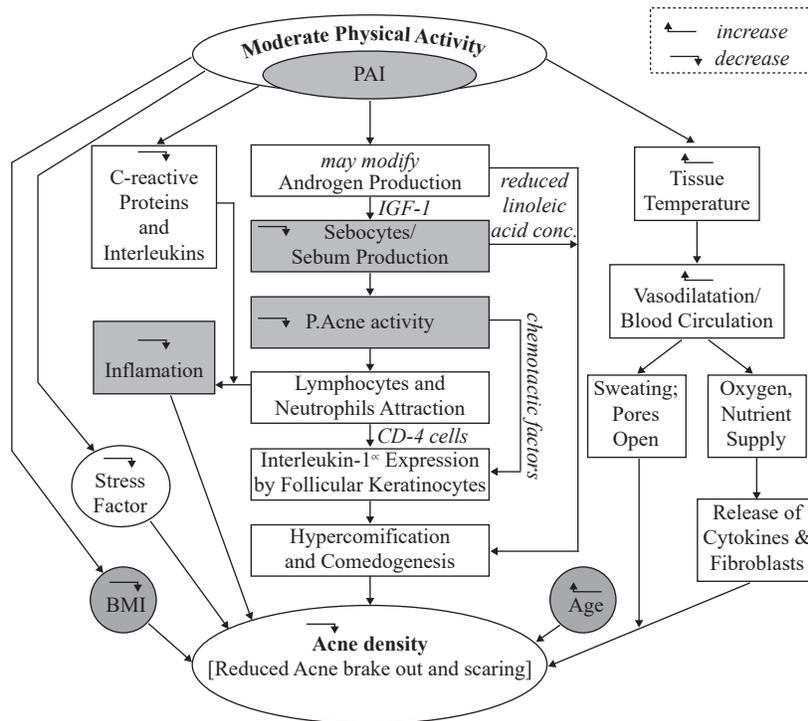


Fig. 1: Acne vulgaris. Researchers' theoretical model.

Subjects' biodata were collected with a researcher made questionnaire. Body mass index (weight (kg)/height (m)<sup>2</sup>) was obtained by a weighing scale and metre rule (RGZ-120; made in China). Physical activity index was estimated using KPAS standardized questionnaire based on its objectivity, validity and reliability (26). Physical activity index ranged from one to five viz: inactive -1, moderately inactive -2, moderately active -3, active -4 and very active -5.

GAGS face map was adopted to describe the distribution and severity of facial acne among subjects (24). The baseline lesion count of comedones, papule, pustule and nodule was recorded for each subject (Table 1). The mean density of acne was calculated and recorded using a 25 cm<sup>2</sup> quadrant (18); based on the arbitrary division of the face into four regions [*via* a mid-sagittal line intercepted by a transverse line connecting the tragus of both ears through the tip of the nose] (25). Patients were requested to cast the quadrant randomly, trice in each of the four regions of the face and the mean lesion count (n) was recorded (density = n/25 cm<sup>2</sup>).

Recruitment and research were completed between May and July, 2016. Data were collated and analysed with SPSS 17 software (SPSS, Chicago). Descriptive statistics was bar chart, percentage, and mean  $\pm$  standard deviation. Inferences - test of hypothesis was derived with multiple regression and Spearman's correlation coefficient.

## RESULTS

One hundred and five male subjects completed the study: age ( $22 \pm 4$  years), BMI ( $25.32 \pm 3.501$ ), PAI ( $2.53 \pm$

$0.382$ ) and density ( $5 \pm 1.689$ ) eruptions per 25 cm<sup>2</sup> of face (Table 1).

Body mass index was stratified into four standard range (n, %); underweight < 18.50 (0, 0.0%), normal 18.50–24.99 (57, 54.3%), overweight 25.00–29.99 (30, 28.6%) and obese  $\geq 30$  [18, 17.1%] (10). The majority of the subjects, 87 (82.9%) had normal skin type while 18 (17.1%) had oily skin. The classification into Fitzpatrick skin types showed: VI, 66 (62.9%); V, 33 (31.4%) and III, 6 (5.7%). On average, the types of acne lesion count per individual was: comedone ( $30.11 \pm 10.00$ ), papule ( $15.54 \pm 8.73$ ), pustule ( $9.40 \pm 7.01$ ) and nodule ( $3.20 \pm 3.47$ ). Figure 2 showed that the age range 17–19 years have more severe disease than other age categories.

Table 2 shows a significant inverse relationship between the age of the subject ( $22.03 \pm 3.877$ ) and density of eruption ( $5.17 \pm 1.689$ ). Analysis made with Spearman's rho correlation coefficient,  $\rho = -0.513$  (C.I = 99%, two-tailed test),  $p = 0.002$ , implies that, as the subjects became older, their density of eruption decreased. Conversely, BMI ( $25.32 \pm 3.501$ ) has no significant relationship with the density of eruption ( $5.17 \pm 1.689$ ). The correlation analysis yielded  $\rho = 0.034$  (C.I = 95%, two-tailed test),  $p = 0.846$ , while the positive coefficient suggest that density of acne increases with increase in BMI (Fig. 3). Likewise, the inverse correlation (Table 2) between PAI ( $2.53 \pm 0.382$ ) and density of acne ( $5.17 \pm 1.689$ ) among the subjects was not statistically significant ( $\rho = -0.313$  [C.I = 95%, two-tailed test]  $p = 0.067$ ).

Multiple regression showed that age, BMI and PAI (when put together) significantly predicted acne severity,  $F(3,101) = 4.272$ ,  $p = 0.012$ ,  $R^2 = 0.293$ .

Table 1: Subject characteristics

Parameters	Age Category (years)				
	17–19 X $\pm$ SD	20–22 X $\pm$ SD	23–25 X $\pm$ SD	26–28 X $\pm$ SD	All X $\pm$ SD
n	33	27	18	27	105
Age	17.73 $\pm$ 0.79	20.89 $\pm$ 0.78	23.50 $\pm$ 0.84	27.44 $\pm$ 0.73	22 $\pm$ 4
BMI	26.33 $\pm$ 3.63	24.57 $\pm$ 3.86	24.74 $\pm$ 1.80	25.21 $\pm$ 4.05	25.32 $\pm$ 3.50
PAI	2.53 $\pm$ 0.50	2.54 $\pm$ 0.37	2.64 $\pm$ 0.25	2.41 $\pm$ 0.33	2.53 $\pm$ 0.38
<b>Acne type:</b>					
Comedone	38.00 $\pm$ 3.49	28.44 $\pm$ 9.63	27.50 $\pm$ 9.71	23.89 $\pm$ 10.98	30.11 $\pm$ 10.00
Papule	21.09 $\pm$ 7.35	16.00 $\pm$ 10.89	11.33 $\pm$ 4.23	11.11 $\pm$ 6.99	15.54 $\pm$ 8.73
Pustule	11.64 $\pm$ 4.86	10.00 $\pm$ 11.35	6.00 $\pm$ 2.68	8.33 $\pm$ 5.39	9.40 $\pm$ 7.01
Nodule	4.36 $\pm$ 3.47	4.00 $\pm$ 4.72	0.83 $\pm$ 1.33	2.56 $\pm$ 2.35	3.20 $\pm$ 3.47
Density*	6.64 $\pm$ 1.03	5.11 $\pm$ 1.69	3.67 $\pm$ 0.52	4.44 $\pm$ 1.59	5.00 $\pm$ 1.68

PAI = Physical activity index (1 – 5) using KPAS questionnaire. Density\* = number of acne lesions per 25 cm<sup>2</sup>. BMI = Body mass index.

Table 2: Correlation between density of acne eruption with Age, BMI and PAI

Parameter	Mean $\pm$ SD	n	Spearman's rho Correlation ( $\rho$ )	Sig. (2-tailed) <i>p</i> -value
Density <sup>†</sup>	5.17 $\pm$ 1.689	105		
Age <sup>‡</sup>	22.03 $\pm$ 3.877	105	- 0.521	0.001**
BMI <sup>‡</sup>	25.32 $\pm$ 3.501	105	0.034	0.846
PAI <sup>‡</sup>	2.53 $\pm$ 0.382	105	- 0.313	0.067

Levels of significance (two-tailed):  $p < 0.001$  (\*\*),  $p < 0.05$  (\*), no significant correlation ( ). Density = number of eruptions per 25 cm<sup>2</sup> of face. BMI = body mass index. PAI = physical activity index (Using KPAS). † = dependent variable, ‡ = predictors.

## DISCUSSION

The study demonstrated the relationship between age and density of facial acne lesion among the subjects. It was evident from the result presented above (Table 1, Fig. 2 and 3) that severity of facial acne decreased with age. The mean baseline density (5.00  $\pm$  1.68) for all the age categories was exceeded by age range 17–19 (6.64  $\pm$  1.03) years and systematically, the slope declined as the ages (years) increased. However, there was a marginal rise in the density of acne at age range 26–28 years (4.44  $\pm$  1.59), afterwards the number of eruptions continued to decline; this was also evident in a large population study [ $n = 2155$ ] (5). We do not know the reason for the phenomenon. The correlation coefficient ( $\rho = -0.521$ ,  $p = 0.001$ , CI = 99%, two-tailed test) and regression coefficient ( $b = -0.231$ ,  $p = 0.002$ ) showed a significantly strong inverse relationship between age and density of acne (Tables. 2 and 4). This outcome is not new in the literature, the present research can only add to the well established body of knowledge that age is an important factor in prevalence of acne. Our work corroborate with the study of Cunliffe and Gould (5) who reported that 18-year-olds had the highest prevalence of clinical acne on the face while the prevalence declined with age ( $n = 1066$  females and 1089 males, age range = 18–70 years). Similarly, another survey (27) reported that the most common age groups to be involved in acne vulgaris were: 16–20 years (185 cases, 59.8%), 21–25 years (60 cases, 19.4 %), 26–30 years (15 cases, 4.5%) and > 30 years (14 cases, 4.5%).

The majority of our subjects 57 (54.3%) had normal BMI, 30 (28.6%) were overweight and 18 (17.1%) were obese. Body mass index of 25 or higher is considered overweight, and 30 or higher is obese in adolescent boys

and girls aged 18 years or older (9). The current study (Table 2) showed no statistically significant relationship between BMI and density of eruption ( $\rho = 0.034$ ,  $p = 0.846$ , CI = 95%). Conversely, it has previously been shown in Taiwan, that boys and girls (age 6–11 years) with lower BMI had a lower prevalence of acne (28). Similarly, in British male soldiers older than 20 years of age, those with acne tended to be heavier (29). Our preliminary observation is consistent with the studies above (Figs. 1 and 3), but the assumption is not significant (Table 2) under the set statistical parameter ( $p \leq 0.05$ ). Recently, it was demonstrated that overweight and obesity are associated with acne in girls aged 18 and 19 year of age, but the same association was not observed in boys (6). The present study is consistent with the latter in the sense that we used only male subjects, the link between observation and result may be traced to gender. We were handicapped by the paucity of published works on association between BMI and acne.

Figure 3 shows an inverse association between acne and PAI. It means that increase in PAI reduces density of acne. Physiotherapists have proposed that moderate intensity exercise or increase PAI would ameliorate acne to an extent (Fig. 1).

However, regression coefficient ( $b = -0.763$ ,  $p = 0.272$ ) in Table 4 and spearman's correlation coefficient ( $\rho = -0.313$ ,  $p = 0.067$ ) in Table 2 showed that the perceived association was not significant (CI = 95%).

The dearth of literature on this aspect possesses more challenges. An author stated that acne breaks out after rigorous physical activities; sweat and stress involved in physical activities aggravate acne, “despite popular myth, lack of exercise do not have any effect on acne” (30). Others opined that increased blood flow following exercise assists the maintenance of skin cells as it brings in oxygen and nutrients while removing waste (31). We conceptualized a secondary effect of PA on acne (Fig. 1).

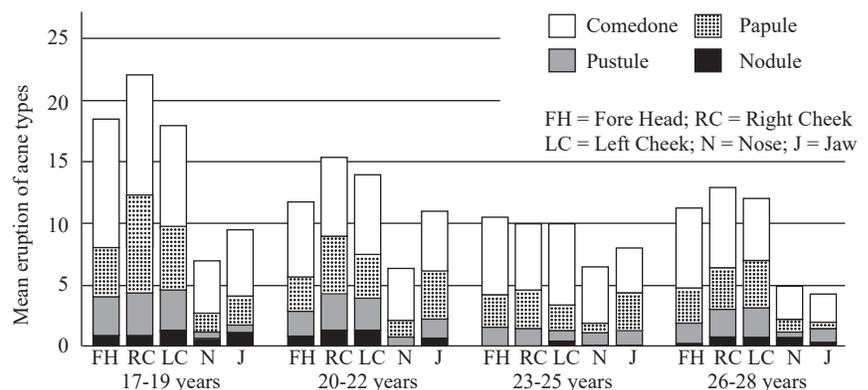


Fig. 2: Acne vulgaris. Distribution by age category, region and type.

Physical activity can reduce stress, BMI, serum level of androgen, insulinaemia (12), IGF-1 (18), and blood markers of inflammation such as CRP (19) and IL (20). It can increase the skin temperature and lead to vasodilatation, sweating and opening up of waxy skin pores, clogged by sebum. Other biochemical exchange related to exercise may be beneficial in resolving inflammatory acne lesions. Prior to this study, we did not know of any study that had investigated the relationship between acne and physical activity.

The ANOVA  $F(3,101) = 4.272, p = 0.012$ , shows an association between density of acne and the dependent variables (Table 3). The regression ( $R^2 = 0.293$ ) shows that the perceived association is 29% indicative by the subject's age, BMI and PAI. Specifically, age ( $b = -0.231, p = 0.002$ ) is the only significant variable in prediction of acne density. The association between facial acne and PAI ( $b = -0.763, p = 0.272$ ) or BMI ( $b = -0.031, p = 0.686$ ) was not statistically significant.

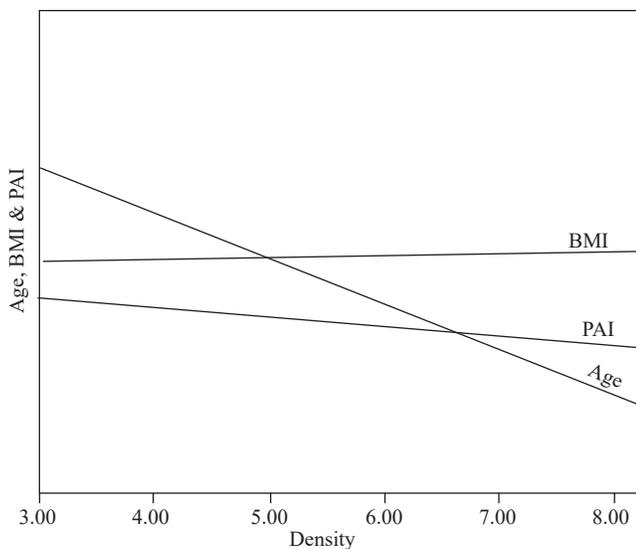


Fig. 3: Acne vulgaris. Linear regression of density against age, BMI and PAI.

Table 4: Regression coefficients

Parameters	Unstandardized Coefficients		Standardized Coefficients			Partial Correlations
	B	Std. Error	Beta	t-value	p-value	
(Constant)	12.963	3.346		3.874	0.001	
Age	-0.231	0.067	-0.531	-3.474	0.002	-0.529
PAI	-0.763	0.682	-0.172	-1.119	0.272	-0.197
BMI	-0.031	0.075	-0.063	-0.408	0.686	-0.073

Dependent Variable: Density

Table 3: Acne vulgaris. ANOVA of dependent variable and predictors

Parameters	Sum of Squares	Df	Mean Square	F	p-value
Regression	28.366	3	9.455	4.272	0.012
Residual	68.606	101	2.213		
Total	96.971	104			

Predictors: (Constant), BMI, Age, PAI. Dependent Variable: Density

Limitations: we could not guarantee non-intrusion of extraneous factors like environmental or genetic predisposition. Exposing the participants to six weeks moderate intensive aerobics on treadmill (and a control group) instead of using questionnaire generated PAI could have been more objective. We excluded females because we could not adjust for the hormonal influences on acne prior and post menstrual cycle. Strengths of this study lie on the rigor with which, the clinician took manually both the anthropometric values and lesion count, without so many electronic gadgets. Except KPAS which is very reliable (26), we did not use self-reported tools for BMI or density of acne. To the best of our knowledge, this is the first study on the association between acne and PAI in this age group.

## CONCLUSION

Pathogenesis of acne is highly dependent on androgen surge in adolescence and young adults. The study substantiated the association between age and severity of acne. A possible link between acne and diet, metabolism, anthropometrics, environment or life style changes is still controversial. However, we found no significant association between acne and body mass or physical activity indices but the level of the correlation between physical activity and acne calls for further investigation.

## LIST OF ABBREVIATIONS

BMI, Body Mass Index; PAI, Physical Activity Index; GAGS, Global Acne Grading Scale; KPAS, Kaiser Physical Activity Survey; PA, Physical Activity; IGF-1, Insulin-Related Growth Factor 1; CRP, C-reactive protein; IL, Interleukins; UNEC, University of Nigeria Enugu Campus; UNTH, University of Nigeria Teaching Hospital.

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## AUTHOR CONTRIBUTIONS

OKK Onyeso conceived the paper, oversaw data collection, conducted data analysis, wrote manuscript and approved final version. CC Anyachukwu and CI Ezema participated in study design, data collection, data analysis and interpretation, critically revised manuscript and approved final version.

**Synopsis:** The study explored the relationship between facial acne severity, age of patients, body mass and physical activity indexes. Acne severity has a significant relationship with age of patients but not body mass or physical activity indexes.

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