ORIGINAL RESEARCH

Investigating the Influence of Nutritional Deficiencies on the Development and Severity of Acne Vulgaris in Adolescents and Young Adults

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Received Date: 13 September, 2020 Acceptance Date: 15 October, 2020

ABSTRACT

Background: Acne vulgaris is a common inflammatory skin condition affecting adolescents and young adults, with significant physical and psychological impacts. Emerging evidence suggests that nutritional deficiencies may influence its development and severity, yet the relationship remains underexplored.**Objective:** To investigate the association between nutritional deficiencies and the severity of acne vulgaris in adolescents and young adults, focusing on key nutrients such as zinc, vitamin A, vitamin D, and omega-3 fatty acids.**Methods:** A cross-sectional study was conducted with 110 participants aged 13–25 years, categorized into mild, moderate, and severe acne groups based on the Global Acne Grading System (GAGS). Nutritional status was assessed through dietary surveys and serum measurements of zinc, vitamin A, vitamin D, and omega-3 fatty acids. Statistical analyses included correlation and multivariate regression to identify associations between nutrient levels, dietary patterns, and acne severity.**Results:** Participants with severe acne had significantly lower serum levels of zinc (57.6 ± 7.8 µg/dL), vitamin A (33.1 ± 4.9 µg/dL), vitamin D (14.6 ± 3.9 ng/mL), and omega-3 fatty acids (2.4 ± 0.7 mg/dL) compared to those with mild acne. High-glycemic index food consumption was more frequent among participants with severe acne (89% vs. 55% in mild acne). Significant inverse correlations were observed between nutrient levels and acne severity (e.g., zinc: $r = -0.56$, $P < 0.01$; vitamin D: $r = -0.62$, $P < 0.01$).**Conclusion:** Nutritional deficiencies, particularly in zinc, vitamin A, vitamin D, and omega-3 fatty acids, are strongly associated with increased acne severity. Dietary patterns high in high-glycemic index foods further exacerbate acne. Addressing these deficiencies through dietary modifications and supplementation may serve as an effective adjunct to conventional acne treatments.

Keywords: Acne vulgaris, nutritional deficiencies, zinc, vitamin D, omega-3 fatty acids, high-glycemic index foods, adolescents, young adults.

INTRODUCTION

Acne vulgaris is a common inflammatory skin condition that significantly affects individuals during adolescence and young adulthood, a period already marked by profound physical, emotional, and social changes. Characterized by the formation of comedones, papules, pustules, and, in severe cases, nodules and cysts, acne primarily affects the face, chest, and back. These areas are rich in sebaceous glands, which play a pivotal role in the condition's pathogenesis [1]. The impact of acne extends beyond the physical symptoms, often leading to psychological distress, including anxiety, depression, and diminished self-esteem. Despite its prevalence, the exact etiology of acne remains complex and multifactorial, with genetics, hormonal fluctuations, and environmental influences all contributing to its manifestation [2].

In recent years, the potential connection between diet and acne has gained increasing attention. While the association between food intake and acne was once dismissed as anecdotal or scientifically unsubstantiated, emerging research suggests that diet can significantly influence skin health and acne outcomes [3]. Central to this hypothesis is the concept that specific nutritional deficiencies may exacerbate acne by contributing to the underlying biological

mechanisms involved, such as increased sebum production, inflammation, oxidative stress, and dysregulated keratinization. The potential role of diet in acne opens the door to new, non-invasive strategies for managing this widespread condition [4]. Nutritional deficiencies are particularly relevant during adolescence and young adulthood, as these life stages are characterized by increased nutritional demands due to growth and development. Many individuals in this age group exhibit suboptimal dietary patterns, including high consumption of processed and sugar-laden foods and low intake of essential vitamins and minerals [5]. These habits are often compounded by lifestyle factors such as busy schedules, inadequate meal planning, and the influence of peer and cultural trends, which prioritize convenience over nutritional quality. Deficiencies in nutrients such as zinc, vitamin A, vitamin D, and omega-3 fatty acids are increasingly recognized for their potential roles in skin disorders, including acne [6].

Zinc, for example, is a trace element critical for immune function and cellular repair. Studies have shown that individuals with acne often exhibit lower serum zinc levels compared to those without the condition. Zinc's anti-inflammatory properties and its role in reducing keratinocyte proliferation may contribute to its potential as a therapeutic agent in acne management. Similarly, vitamin A is essential for regulating cell growth and differentiation in the skin. Deficiencies in this nutrient may lead to abnormal keratinization and an increase in sebum production, both of which are hallmarks of acne development [7]. Vitamin D, known for its immunomodulatory effects, also plays a role in maintaining skin barrier integrity and reducing inflammation. Research suggests that lower levels of vitamin D may correlate with increased acne severity. Omega-3 fatty acids, which are known to combat inflammation and oxidative stress, are another dietary component often lacking in modern diets. The imbalance of omega-3 and omega-6 fatty acids may contribute to an inflammatory environment conducive to acne progression [8] . This investigation aims to elucidate the relationship between nutritional deficiencies and acne vulgaris, focusing on adolescents and young adults. By synthesizing evidence from clinical studies, dietary analyses, and mechanistic research, this study seeks to identify specific nutrient deficiencies that may exacerbate acne. Understanding these connections could provide critical insights into the development of integrative treatment strategies that include dietary modifications as a complementary approach to traditional therapies. Moreover, exploring the role of diet in acne has significant public health implications. If nutritional interventions prove effective in mitigating acne, they could offer an accessible, cost-effective, and non-invasive means of treatment, potentially reducing the reliance on pharmacological therapies that often come with side effects [9] .

Objective

The main objective of the study is to find the influence of nutritional deficiencies on the development and severity of acne vulgaris in adolescents and young adults.

Methodology

This cross-sectional study was conducted and total of 110 participants, aged 13–25 years, were recruited for this study. Patients diagnosed with acne vulgaris by a dermatologist, falling within the mild, moderate, or severe categories based on the Global Acne Grading System (GAGS) were included in the study. Participants with systemic conditions affecting skin health, those on long-term medication (e.g., isotretinoin, corticosteroids), or those with dietary restrictions unrelated to the study, such as food allergies were excluded.Participants were recruited through dermatology clinics, social media platforms, and academic institutions. Informed consent was obtained from all participants or their guardians (for individuals under 18), and ethical approval was secured from the relevant institutional review board.

Data Collection

Data collection involved three key components: dermatological evaluation, dietary assessment, and biochemical analysis.A trained dermatologist assessed acne severity using the GAGS scoring system. This system evaluates acne based on lesion type and distribution across various regions of the body.Participants were categorized into mild, moderate, or severe acne groups based on their GAGS scores.Dietary intake was evaluated using a validated food frequency questionnaire (FFQ) and 3-day dietary recall. These tools were used to estimate the participants' nutrient intake, focusing on vitamins (A, D, E), minerals (zinc, selenium), and omega-3 fatty acids.Participants were also surveyed on dietary habits, such as consumption of processed foods, sugary beverages, and high-glycemic index foods.

Biochemical Analysis

Blood samples were collected from each participant to measure serum levels of key nutrients, including zinc, vitamin A, vitamin D, and omega-3 fatty acids. Standardized laboratory techniques and equipment were employed to ensure accuracy and reliability. Inflammatory markers (e.g., C-reactive protein) were also assessed to explore potential links between systemic inflammation and acne severity.

Statistical Analysis

Data were analyzed using SPSS v11. Demographic data and nutrient levels were summarized using means, medians, and standard deviations.Differences in nutrient levels between acne severity groups (mild, moderate, severe) were evaluated using ANOVA or Kruskal-Wallis tests for non-parametric data.

RESULTS

Data were collected from 110 participants. The distribution of participants across acne severity groups indicates a slight increase in mean age with greater acne severity, with participants in the severe acne group averaging 19.2 ± 3.5 years compared to 17.6 ± 3.1 years in the mild acne group. Gender distribution remained relatively consistent, with females comprising the majority across all groups (64% overall), suggesting that acne severity is not significantly influenced by gender in this sample.

Table 1: Participant Demographics and Acne Severity Distribution

Characteristic	Mild Acne (n = 40)	Moderate Acne (n = 45)	Severe Acne (n = 25)	Total (n = 110)
Mean Age (years)	17.6 ± 3.1	18.9 ± 3.2	19.2 ± 3.5	18.4 ± 3.2
Gender (Female)	24 (60%)	30 (66.7%)	16 (64%)	70 (64%)
Gender (Male)	16 (40%)	15 (33.3%)	9 (36%)	40 (36%)

A clear trend emerges showing that serum levels of zinc, vitamin A, vitamin D, and omega-3 fatty acids decrease as acne severity increases. For example, zinc levels drop from 69.8 ± 7.2 µg/dL in participants with mild acne to 57.6 ± 7.8 µg/dL in those with severe acne ($P<0.01$). Similarly, vitamin D levels decrease from 22.1 ± 4.1 ng/mL in mild cases to 14.6 ± 3.9 ng/mL in severe cases. The significant P-values (< 0.01) indicate strong statistical support for these differences, emphasizing the potential role of these nutrients in acne pathogenesis.

Table 2: Nutrient Levels Stratified by Acne Severity

Nutrient	Mild Acne (n = 40)	Moderate Acne (n = 45)	Severe Acne (n = 25)	P-value
Zinc (µg/dL)	69.8 ± 7.2	63.1 ± 6.5	57.6 ± 7.8	< 0.01
Vitamin A (µg/dL)	42.3 ± 5.8	37.4 ± 5.6	33.1 ± 4.9	< 0.01
Vitamin D (ng/mL)	22.1 ± 4.1	18.2 ± 3.5	14.6 ± 3.9	< 0.01
Omega-3 (mg/dL)	3.9 ± 0.8	3.0 ± 0.6	2.4 ± 0.7	< 0.01

The correlation analysis reveals significant negative associations between nutrient levels and acne severity. Vitamin D exhibits the strongest inverse correlation ($r=-0.62$, $P<0.01$), followed by omega-3 fatty acids ($r=-0.58$, $P<0.01$) and zinc ($r=-0.56$, $P<0.01$). This suggests that lower nutrient levels are consistently linked to higher acne severity, highlighting these nutrients as potential modifiable factors in managing acne.

Table 3: Correlation Between Nutrient Levels and Acne Severity (GAGS Scores)

Nutrient	Correlation Coefficient (r)	P-value
Zinc	-0.56	< 0.01
Vitamin A	-0.49	< 0.01
Vitamin D	-0.62	< 0.01
Omega-3	-0.58	< 0.01

The data indicates a significant association between dietary habits and acne severity. A higher proportion of individuals with severe acne reported consuming high-glycemic index foods frequently (89%) compared to those with moderate (71%) and mild acne (55%), with a statistically significant trend. Similarly, fruit and vegetable intake showed a marked decrease with increasing acne severity, as individuals with severe acne consumed significantly fewer servings per day (1.5 ± 0.7) than those with moderate (2.4 ± 0.9) and mild acne (3.2 ± 0.8). These findings suggest that a high-glycemic index diet and low fruit and vegetable consumption are associated with worsening acne severity.

Table 4: Dietary Patterns by Acne Severity

Dietary Pattern	Mild Acne (n = 40)	Moderate Acne (n = 45)	Severe Acne (n = 25)	P-value
High-GI Foods (% reporting ≥5 times/week)	55%	71%	89%	< 0.01
Fruits/Vegetables (servings/day)	3.2 ± 0.8	2.4 ± 0.9	1.5 ± 0.7	< 0.01

The multivariate analysis identified key predictors for severe acne, with significant odds ratios and confidence intervals. Vitamin D deficiency, defined as levels below 20 ng/mL, showed the strongest association, with an odds ratio of 3.2 and a substantial increase in risk. Zinc deficiency, defined as levels below 60 µg/dL, was also a strong predictor, with an odds ratio of 2.7. Additionally, a high-glycemic index diet was linked to severe acne, with an odds ratio of 2.5, though its impact was slightly less pronounced than the nutrient deficiencies.

Table 5: Multivariate Analysis of Predictors for Severe Acne

Predictor	Odds Ratio (OR)	95% Confidence Interval (CI)	P-value
Vitamin D deficiency (<20 ng/mL)	3.2	1.8–5.5	< 0.01
Zinc deficiency (<60 µg/dL)	2.7	1.4–4.9	< 0.01
High-GI diet	2.5	1.3–4.2	< 0.05

DISCUSSION

This study aimed to investigate the influence of nutritional deficiencies on the development and severity of acne vulgaris among adolescents and young adults. The results demonstrated significant associations between lower serum levels of zinc, vitamin A, vitamin D, and omega-3 fatty acids and increased acne severity. Additionally, participants with severe acne reported dietary patterns characterized by higher consumption of high-glycemic index (GI) foods and lower intake of fruits, vegetables, and nutrient-dense foods[10]. These findings align with emerging evidence highlighting the role of nutrition in acne pathogenesis and support the hypothesis that addressing nutritional deficiencies may mitigate acne severity. The inverse correlations observed between serum nutrient levels and acne severity underscore the potential importance of micronutrients in skin health. Zinc, for example, exhibited a strong negative correlation with acne severity ($r = -0.56$, $P < 0.01$) [11]. Zinc is known for its anti-inflammatory properties, its role in regulating sebum production, and its contribution to keratinocyte repair. Participants with severe acne displayed significantly lower zinc levels (57.6 ± 7.8 µg/dL) compared to those with mild acne (69.8 ± 7.2 µg/dL), suggesting that zinc supplementation could be a valuable intervention. Vitamin A, essential for regulating cell differentiation and maintaining skin integrity, also showed a significant negative correlation with acne severity $r = -0.49$, $P < 0.01$) [12]. Deficiencies in vitamin A can exacerbate abnormal keratinization and increase sebaceous gland activity, both of which are hallmarks of acne. Participants with severe acne had notably lower vitamin A levels than those with mild or moderate acne, reinforcing its potential as a therapeutic target [13]. Vitamin D, often referred to as the "sunshine vitamin," demonstrated the strongest correlation with acne severity ($r = -0.62$, $P < 0.01$). Vitamin D's immunomodulatory effects and its role in reducing inflammation may explain this relationship. Omega-3 fatty acids, known for their anti-inflammatory and antioxidant properties, were also significantly lower in participants with severe acne (2.4 ± 0.7 mg/dL) compared to those with mild acne (3.9 ± 0.8 mg/dL). The imbalance between omega-3 and omega-6 fatty acids in modern diets may promote a pro-inflammatory state that exacerbates acne [14]. These findings suggest that dietary interventions to increase omega-3 intake, such as incorporating fatty fish or supplements, could be beneficial. The dietary patterns observed in this study further support the role of diet in acne development [15]. Participants with severe acne consumed high-GI foods more frequently and had lower intake of fruits and vegetables, which are rich sources of antioxidants and essential vitamins. High-GI foods can trigger rapid spikes in insulin levels, promoting hormonal changes that increase sebum production and inflammation. This dietary behavior may exacerbate acne severity, as evidenced by the higher prevalence of high-GI diets among participants with severe acne [16].

The findings of this study have important public health implications. Nutritional interventions, such as zinc supplementation, vitamin D therapy, and increased omega-3 intake, could serve as cost-effective and non-invasive strategies to complement conventional acne treatments. Educating adolescents and young adults about the potential impact of dietary choices on skin health may empower them to adopt healthier eating habits, reducing both the physical and psychological burden of acne.

CONCLUSION

It is concluded that nutritional deficiencies, particularly in zinc, vitamin A, vitamin D, and omega-3 fatty acids, are significantly associated with the severity of acne vulgaris in adolescents and young adults. Addressing these deficiencies through dietary modifications and supplementation may serve as an effective adjunct to conventional acne treatments. Promoting healthier dietary habits could also contribute to improved skin health and overall well-being.

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