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The Relationship between Vitamin D, Body Mass Index and some Dietary Products with Acne Vulgaris; A Case-Control study in Baghdad/Iraq

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Abstract

Objective: To investigate the association of vitamin D level and moderate to severe acne as a primary outcome, and its association with BMI, dairy products, and chocolate consumption.

Methods: A case-control study was conducted in a dermatology outpatient clinic. Patients, diagnosed with moderate to severe acne vulgaris that warrant treatment with oral antibiotics, and had global acne grading system (GAGS) score of >=19 were eligible to be selected as cases. Aged matched, with no or mild cases of acne were eligible to be selected as controls. The participant height, weight, BMI, and serum circulating 25-hydroxyvitamin D level were measured. A modified food frequency questionnaire was used for dietary history.

Results: Comparing Cases ($N = 101$) and Control ($N = 134$), the mean of vitamin D level in cases were lower than that in the controls, however no statistically significant difference is observed. There were statistically insignificant differences between the studied groups regarding milk (whole, low fat, skimmed and any type of milk), cheese, yogurt, other dairy products, and chocolate consumption. However, a statistically significant disparity in weight is noted, but not in BMI.

Conclusion: The results did not reveal any statistically significant associations between vitamin D level, BMI, dairy and chocolate consumption, and moderate to severe acne. However, it is important to note that this does not definitively rule out the possibility of any potential relationships or effects.
Keywords: Acne, vitamin D, dairy product, chocolate

Introduction

Acne remains the most common inflammatory dermatosis treated worldwide, as estimated by global skin disease prevalence studies.[1] The chronic nature of acne and resultant scarring contribute to significant physical, social, psychological, and economic burden.[2-4] The significant disease burden resulting from acne and the continuing use of antibiotics support the need for therapeutic advances.[1]

Acne vulgaris is an inflammatory disorder of the pilosebaceous unit, which is comprised of the hair follicle and sebaceous gland. The pathogenesis of acne involves a complex interplay of host factors, such as androgen-mediated stimulation of sebaceous glands, dysbiosis within the microbiome of the pilosebaceous follicle, and innate and cellular immune responses, and may be influenced by factors such as genetics and, possibly, diet.[5]

Newer evidence that sebocyte activity being controlled via a range of cellular pathways apart from androgen alone, dietary influence on acne, emphasizes the complex pathogenesis of acne.[6] Cutibacterium acnes (C. acnes, formerly *Propionibacterium acnes*) is a non-pathogenic resident of the human skin, as well as mucosal surfaces. However, it also has been demonstrated that C. acnes plays a pathogenic role in diseases such as acne vulgaris.[7]

In addition to its role in calcium and bone homeostasis, vitamin D contributes to the regulation of many other cellular functions. Although a large number of epidemiologic studies indicate that the risks of cancer and infectious, autoimmune, and cardiovascular diseases are higher when 25-hydroxyvitamin D (25[OH]D) levels are <20 ng/mL (50 nmol/L) and that risks decrease with higher 25(OH)D concentrations.[8] Vitamin D may play regulatory roles in the C. acnes-induced IL-17 response; in an in vitro study, C. acnes-mediated IL-17 induction was inhibited by exposure of peripheral blood mononuclear cells to vitamin D.[9] Vitamin D activates the innate immune system, particularly monocytes and macrophages.[10]

The role of diet in acne vulgaris is an evolving concept. A contributory effect of milk and high glycemic index diets has been proposed, but prospective trials are necessary to clarify the relationship between diet and acne.[11] One review focuses on dietary and therapeutic interventions and assesses the effect of various approaches such as improving diet by avoiding certain food products (i.e., milk and chocolate) or increasing the intake of others (i.e., food products rich in omega-3 fatty acids), on the improvement of certain acne vulgaris severity parameters. These therapeutic approaches, when combined with allopathic treatment, can improve the patients' quality of life.[12]

This study aimed to investigate the association of vitamin D level and moderate to severe acne as a primary outcome, the secondary outcomes include the association of BMI, dairy products, and chocolate consumption and moderate to severe acne.

Materials & Methods

A case-control study was conducted in the Dermatologic Outpatient Clinic in Al-Yarmouk Teaching Hospital in Baghdad. Full evaluation including patient's history for identifying patients with acne, caused or exacerbated by an exposure (eg, drug-induced acne) or who may need further evaluation for associated disease, and physical examination as the diagnosis is based upon recognition of characteristics lesions (closed comedones, open comedones, inflammatory papules, inflammatory pustules, inflamed nodules) in a characteristic distribution (eg, face chest, shoulders, back, or upper arms) during skin examination.[11]

Patients aged 12–40 years,[11] diagnosed with moderate to severe acne vulgaris that warrant treatment with oral antibiotics, as judged by the study clinicians; and had global acne grading system (GAGS) score of >=19 (moderate or worse)[13–15] were eligible to be selected as cases. Aged matched, with no or mild cases of acne (does not require oral antibiotics and score <19 GAGS) were eligible to be selected as controls, were identified between August and November 2023. Score of 1–18 = mild, 19–30 = moderate, 31–38 = sever, >39 = very sever.

The participants' heights were measured, with 0.1 cm accuracy with non-stretchable tape, while body weights were measured with digital floor scale without shoes and with minimum clothing, BMI was calculated by dividing body weight (in kilogram) by square of stature (height, in meter).[16]

A modified food frequency questionnaire (FFQs) was completed during the interview based on frequency of eating a serving of dairy products or chocolate per day, week or month or never eating. The serving size for dairy product (1 cup equivalent) was 1 cup of milk, yogurt; 1.5 ounces natural cheese like cheddar cheese (pair of dice) or 2 ounces processed cheese (4 tablespoon (Tbsp)) and 1/3 cup shredded cheese,[17] while serving size for chocolate was as chocolate bars which approximately contain 50 grams of chocolate,[18] which is equivalent to 3.3 Tbsp of chocolate spread.

Serum circulating 25-hydroxyvitamin D [25(OH)D] level, measured by a reliable assay, to evaluate vitamin D status. Vitamin D sufficiency is defined as a 25(OH)D concentration ≥20 ng/mL (50 nmol/L), vitamin D insufficiency is defined as a 25(OH)D concentration of 12 to <20 ng/mL (30 to 50 nmol/L), vitamin D deficiency is defined as a 25(OH)D level <12 ng/mL (30 nmol/L), while a "risk" of vitamin D toxicity is defined as a 25(OH)D level >100 ng/mL (>250 nmol/L).[19]

The exclusion criteria were as follows:

1. Individuals who had taken oral isotretinoin and/or vitamin D supplementation within the past six months.
2. Individuals who had taken oral antibiotics for acne within the previous month.
3. Individuals who had started, stopped, or changed hormonal contraception within the past three months.
4. Individuals on corticosteroid treatment or any medication that affects vitamin D metabolism (ketoconazole, rifampin, phenytoin, isoniazid).
5. Individuals suffering from active malignancy or other chronic systemic diseases.
6. Female Individuals with pregnancy and lactation.

Statistical Analysis

Continuous variables were expressed as means and standard deviations. Categorical variables were expressed as frequency and percentages. The Welch's *t*-test was performed for normally continuous variables. The difference between categorical variables was investigated using either the χ2 test or Fisher's exact test, depending on the context. Spearman's rank correlation Coefficient was used to study the correlation between GAS score and vitamin D levels.

A *P*-value less than 0.05 was considered statistically significant. R software packages (dplyr, gt_summery and ggplot) were used for data processing, visualization, and statistical analysis ("R version 4.2.2, R Foundation for Statistical Computing, Vienna, Austria").

Results

In this case-control study comparing patients with moderate to severe acne (Cases, $N = 101$) and those with mild or without acne (Control, $N = 134$), Table 1 presents a comprehensive overview of demographic characteristics. Notably, a significant difference in age is observed, with cases exhibiting a mean age of 23.6 ± 5.8 years, while controls have a higher mean age of 27.7 ± 4.4 years ($P < 0.001$). The gender distribution, though not statistically significant ($P = 0.089$), reveals a higher percentage of females among both Cases (92.1%) and Controls (97.0%). A modest but statistically significant disparity in weight is noted, with Cases having a mean weight of 63.5 ± 13.2 kg, compared to Controls with 67.2 ± 11.5 kg ($P = 0.027$). Height and BMI differences, while showing trends, do not reach statistical significance ($P = 0.063$ and $p = 0.10$, respectively).

Table 2 elucidates the comparison between the two study groups, presenting their vitamin D levels and milk intake patterns. In terms of vitamin D levels, the mean of vitamin D level in cases (16.3 ± 10.2) were lower than that in the control (18.3 ± 12.1), however no statistically significant difference is observed (*P*-value = 0.2). Regarding the difference in milk consumption between the two study groups, although 44% of controls never drink whole milk compared to 37% of cases, there is no significant difference in the consumption of whole milk between the groups ($P = 0.6$). Similarly, for low-fat and skimmed milk, no significant disparities are noted ($P = 0.9$ and $P = 0.4$, respectively). Same wise, the collective analysis of any type of milk consumption reveals 35.8% of controls never drink any type of milk compared to 25.7% of cases, but no significant distinction between cases and controls (*P*-value = 0.2).

Table 3 presents a comparison of other dairy product consumption between the case and control groups. For cheese consumption, no statistically significant difference is observed between the groups ($P = 0.6$). Most participants report weekly servings, with Cases at 44.6% and Controls at 50.7%, highlighting a consistent dietary pattern. Similarly, the analysis of other dairy products, including serving/month, serving/week, and serving/day, reveals no significant disparities

Table 1. **Description of patient's demographics**

Characteristic	Case ($N = 101$)[1]	Control ($N = 134$)[1]	*P*-value[2]
Age	23.6 ± 5.8	27.7 ± 4.4	**<0.001**
Gender			0.089
Female	93 (92.1%)	130 (97.0%)	
Male	8 (7.9%)	4 (3.0%)	
Weight	63.5 ± 13.2	67.2 ± 11.5	**0.027**
Height	1.6 ± 0.1	1.6 ± 0.1	0.063
BMI	24.8 ± 4.7	25.8 ± 4.5	0.10

[1]Mean ± SD; *n* (%); [2]Welch Two Sample *t*-test; Pearson's Chi-squared test.

Table 2. **Comparison between the two study groups regarding their vitamin D levels and milk intake**

Characteristic	Case ($N = 101$)[1]	Control ($N = 134$)[1]	*P*-value[2]
Vitamin D	16.3 ± 10.2	18.3 ± 12.1	0.2
Whole milk			0.6
Never	37 (36.6%)	59 (44.0%)	
Serving/Month	36 (35.6%)	46 (34.3%)	
Serving/Week	21 (20.8%)	20 (14.9%)	
Serving/Day	7 (6.9%)	9 (6.7%)	
Low fat milk			0.9
Never	71 (70.3%)	89 (66.4%)	
Serving/Month	25 (24.8%)	35 (26.1%)	
Serving/Week	5 (5.0%)	9 (6.7%)	
Serving/Day	0 (0.0%)	1 (0.7%)	
Skimmed milk			0.4
Never	85 (84.2%)	106 (79.1%)	
Serving/Month	12 (11.9%)	18 (13.4%)	
Serving/Week	4 (4.0%)	6 (4.5%)	
Serving/Day	0 (0.0%)	4 (3.0%)	
Any type of milk			0.2
Never	26 (25.7%)	48 (35.8%)	
Serving/Month	41 (40.6%)	47 (35.1%)	
Serving/Week	27 (26.7%)	26 (19.4%)	
Serving/Day	7 (6.9%)	13 (9.7%)	

[1]Mean ± SD; *n* (%); [2]Welch Two Sample *t*-test; Pearson's Chi-squared test; Fisher's exact test.

Table 3. **Comparison of other dairy products consumption between the two study groups**

Characteristic	Case ($N = 101$)[1]	Control ($N = 134$)[1]	*P*-value[2]
Cheese			0.6
Never	10 (9.9%)	11 (8.2%)	
Serving/Month	19 (18.8%)	28 (20.9%)	
Serving/Week	45 (44.6%)	68 (50.7%)	
Serving/Day	27 (26.7%)	27 (20.1%)	
Yogurt			0.2
Never	8 (7.9%)	15 (11.2%)	
Serving/Month	32 (31.7%)	30 (22.4%)	
Serving/Week	47 (46.5%)	61 (45.5%)	
Serving/Day	14 (13.9%)	28 (20.9%)	
Other dairy product			0.7
Never	33 (32.7%)	38 (28.4%)	
Serving/Month	54 (53.5%)	76 (56.7%)	
Serving/Week	12 (11.9%)	14 (10.4%)	
Serving/Day	2 (2.0%)	6 (4.5%)	
Any dairy product			0.9
Never	1 (1.0%)	3 (2.2%)	
Serving/Month	11 (10.9%)	12 (9.0%)	
Serving/Week	49 (48.5%)	66 (49.3%)	
Serving/Day	40 (39.6%)	53 (39.6%)	

[1]*n* (%); [2]Pearson's Chi-squared test; Fisher's exact test.

between Cases and Controls ($P = 0.7$). The examination of any dairy product consumption yields no statistical significance between the groups ($P = 0.9$). The analysis of yogurt consumption demonstrates no significant difference ($P = 0.2$). Cases reported majorly weekly consumption (46.5%), same with Controls having more prevalent weekly (45.5%) yogurt intake.

Table 4 delves into the comparison of chocolate consumption between the case and control groups in the study cohort. The analysis reveals no statistically significant difference in chocolate consumption patterns ($P = 0.4$). Weekly chocolate servings are reported by 33.7% of Cases and 40.3% of Controls, indicating a relatively common dietary habit across both groups. Similarly, monthly chocolate servings show comparable proportions, with 36.6% for Cases and 34.3% for Controls. Daily chocolate consumption is reported by 20.8% of Cases and 13.4% of Controls, suggesting a modest disparity in frequency. Notably, a small percentage in both groups, 8.9% of Cases and 11.9% of Controls, report never consuming chocolate.

Figure 1 presents a scatter plot illustrating the correlation between vitamin D levels and the Global Acne Severity (GAS) score, incorporating data from both the case and control groups. The calculated correlation coefficient (R) of –0.1 suggests a weak negative correlation, implying that as vitamin D levels decrease, there may be a slight tendency for the GAS score to be higher. However, the association is not statistically significant with a *p*-value of 0.12.

Table 4. **Comparison of chocolate consumption between the two study groups**

Characteristic	Case ($N = 101$)[1]	Control ($N = 134$)[1]	*P*-value[2]
Chocolate			0.4
Never	9 (8.9%)	16 (11.9%)	
Serving/Month	37 (36.6%)	46 (34.3%)	
Serving/Week	34 (33.7%)	54 (40.3%)	
Serving/Day	21 (20.8%)	18 (13.4%)	

[1]*n* (%); [2]Pearson's Chi-squared test.

Discussion

This study aimed to assess the association between vitamin D levels, dairy products, chocolate consumption and BMI with moderate to severe acne vulgaris. In terms of vitamin D levels, mean level of vitamin D in cases (16.3 ± 10.2) were lower than that in the control (18.3 ± 12.1), however no statistically significant difference is observed. While the calculated correlation coefficient (R) of –0.1 suggests a weak negative correlation, implying that as vitamin D levels decrease, there may be a slight tendency for the GAS score to be higher. However, the association is not statistically significant. Both means below sufficient level of vitamin D (<20 ng/mL), which may be due to the high prevalence of serum vitamin D deficiency in Iraq,[20] as the vitamin D deficiency occurs mainly in the

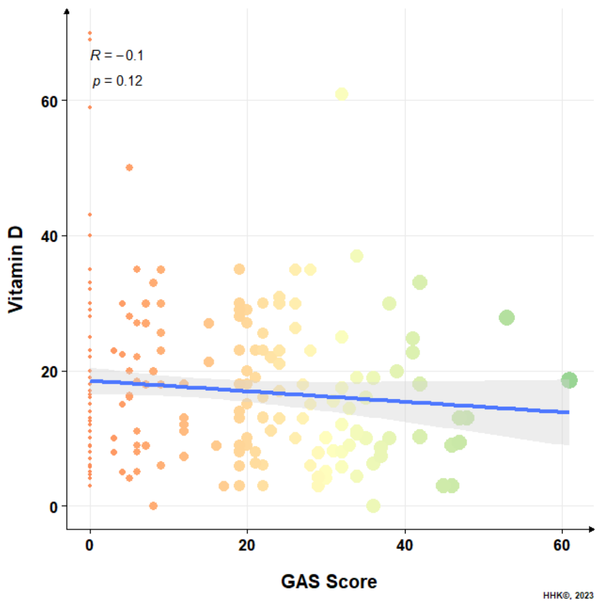

Fig. 1 **Scatter plot showing the correlation between vitamin D levels and the GAS score.**

Middle East.[21] Similar findings were reported in a case-control study by Hasamoh et al., who found no significant association between vitamin D levels and the severity of acne vulgaris, which was conducted in Saudi Arabia.[22]

In contrast to our finding a systemic review included 10 studies found that all studies (8 of 10) revealed lower serum 25-hydroxy vitamin D levels as the acne severity progresses, although 2 of them were not statistically significant.[23] A small sample size case control study (33 cases and 25 controls receiving vitamin D supplement) in Iraq found that vitamin D deficiency was more frequent in patients with acne, which was inversely related with disease severity, however patient in control group had receive vitamin D supplementation.[24] Another case control study showed vitamin D deficiency is evident in acne vulgaris patients and a statistically significant association with the severity of acne lesions, that included 162 unmarried females only, of 12–30 years of age and Vitamin D levels were sorted as adequate (>30 ng/ml), while in this study the age group was 12–40 years and vitamin D was sorted as sufficient (≥20 ng/ml).

Regarding the difference in milk consumption between the two study groups, although 44% of the control group never drink whole milk compared to 37% of cases, similarly the collective analysis of any type of milk consumption reveals 35.8% of controls never drink any type of milk compared to 25.7% of cases but both findings were not significant. Same wise, for low-fat and skimmed milk, no significant disparities are noted. While the literature on whether dairy product intake is associated with acnegenesis is mixed and may be dependent on sex, ethnicity, and cultural dietary habits. Increased dairy consumption may have been proacnegenic in select populations, such as those in which a Western diet is prevalent.[25] In Iraq the average share of fast food (mostly western food) expenditure to total mainly homemade expenditure is 29.59%.[26]

In contrast to our findings, Norwegian longitudinal study found that high intakes (≥2 glasses per day) of full-fat dairy products were associated with moderate to severe acne, in adolescent boys, while a high total intake of dairy products was associated with acne in girls; in this study high intake was defined as ≥ 1 glass per day, they also found that no significant associations were found between acne and intake of semi-skimmed or skimmed dairy products, and not with moderate intakes of any fat variety of dairy products,[27] which is consistent with our findings.

Aalemi et al. found that the risk of developing moderate to sever acne after frequent consumption of whole milk was increased in those with a family history of acne in siblings and reduced in subjects doing physical exercise.[28]

For cheese and yogurt consumption, no statistically significant difference is observed between the groups. Which is consistent with Aghasi et al. meta-analysis that found no significant association between yogurt/cheese and acne development,[29] and another case control study.[30]

The examination of any dairy product consumption yields no statistical significance between the groups, which agreed with another case control study.[28] A systematic review and meta-analysis found that any dairy, such as milk, yogurt, and cheese, was associated with an increased OR for acne in individuals aged 7–30 years. However, results were affected by heterogeneity and bias across studies.[31] While case control study found that dairy intake was significantly higher among non-acne patients than those with acne.[32]

Daily chocolate consumption is reported in 20.8% of cases compared to only 13.4% of controls, however the analysis reveals no statistically significant difference in chocolate consumption patterns. studies on the exacerbation of acne as a result of chocolate consumption remain controversial due to the additives found in it, such as fat and sugar.[33] Cocoa percentage might also be an influential factor, as it has been observed that dark chocolate has fewer comedogenic effects given it's antioxidant properties.[34] In a population of Polish male adolescents, the most prominent influencing factors was non-chocolate confectionary and had a proacnegenic effect.[35] While a case control study found that consumption of chocolate was positively associated with acne.[28]

A modest but statistically significant disparity in weight is noted, with Cases having a mean weight of 63.5 ± 13.2 kg, compared to Controls with 67.2 ± 11.5 kg, which is consistent with Bajelan et al study.[32] BMI differences, while showing trends, do not reach statistical significance. A mini review stated that Regarding body mass index (BMI) and acne severity, there are many controversies based on different geographic populations as well as age and gender related categories.[36] A cross-sectional study was conducted among 143 adolescents aged between 12 and 18 found that the prevalence of acne did not differ significantly between teenagers with different BMI. However, those who were overweight or obese suffer from the inflammatory type of acne more often compared with others.[37] Another study found that there were statistically significant differences in body mass index between Control and Patients (23.55 kg/m^2 versus 26.74 kg/m^2), respectively.[24]

The national institute for health and care excellence (NICE) guidelines on management of acne vulgaris recommend advising people that there is not enough evidence to support specific diets for treating acne as the limited evidence of benefit did not outweigh the risk. However, the committee thought that it is generally useful to promote a healthy balanced diet, so they added a recommendation linking to Public Health England's advice about this topic.[38]

Study Limitation

Dietary history in the study was self-reported and subjected to recall bias. Due to the nature of the study design used, this study was only able to determine the association, but not the cause and effect of diet on acne vulgaris. The amount of cocoa in chocolate was not determined in this study. Other confounding factors such as stress, inadequate sleep, smoking, family history and facial hygiene care should also been taken into account in future studies.

Conclusion

The results of this case-control study did not reveal any statistically significant associations between vitamin D level, BMI, dairy consumption, chocolate consumption, and the presence of moderate to severe acne vulgaris except for weight. However, it is important to note that this does not definitively rule out the possibility of any potential relationships or effects. Further research with larger sample sizes and more diverse populations may be necessary to explore these factors in greater detail and determine if there are any significant associations that were not captured in this study.

Ethics Approval and Consent to Participate

This study was approved by the Arab Board Committee.

Written consent was obtained from each participant after the main researcher described the study procedures.

Conflict of Interest

None.

References

1. Layton AM, Thiboutot D, Tan J. Reviewing the global burden of acne: how could we improve care to reduce the burden? British Journal of Dermatology [Internet]. 2021 Feb 1 [cited 2023 Dec 4];184(2):219–25. Available from: https://dx.doi.org/10.1111/bjd.19477
2. Tan J, Beissert S, Cook-Bolden F, Chavda R, Harper J, Hebert A, et al. Impact of facial and truncal acne on quality of life: A multi-country population-based survey. JAAD Int. 2021 Jun 1;3:102–10.
3. Sachdeva M, Tan J, Lim J, Kim M, Nadeem I, Bismil R. The prevalence, risk factors, and psychosocial impacts of acne vulgaris in medical students: a literature review. Int J Dermatol [Internet]. 2021 Jul 1 [cited 2023 Dec 4];60(7):792–8. Available from: https://pubmed.ncbi.nlm.nih.gov/33128470/
4. Yang J, Yang H, Xu A, He L. A Review of Advancement on Influencing Factors of Acne: An Emphasis on Environment Characteristics. Front Public Health. 2020 Sep 17;8:551037.
5. O'Neill AM, Gallo RL. Host-microbiome interactions and recent progress into understanding the biology of acne vulgaris. Microbiome 2018 6:1 [Internet]. 2018 Oct 2 [cited 2023 Sep 2];6(1):1–16. Available from: https://link.springer.com/articles/10.1186/s40168-018-0558-5
6. Hazarika N. Acne vulgaris: new evidence in pathogenesis and future modalities of treatment. https://doi.org/101080/0954663420191654075 [Internet]. 2019 [cited 2023 Sep 2];32(3):277–85. Available from: https://www.tandfonline.com/doi/abs/10.1080/09546634.2019.1654075
7. Kraaijvanger R, Veltkamp M. The Role of Cutibacterium acnes in Sarcoidosis: From Antigen to Treatable Trait? Microorganisms 2022, Vol 10, Page 1649 [Internet]. 2022 Aug 15 [cited 2023 Sep 3];10(8):1649. Available from: https://www.mdpi.com/2076-2607/10/8/1649/htm
8. Roger Bouillon. Vitamin D and extraskeletal health [Internet]. [cited 2023 Sep 2]. Available from: https://medilib.ir/uptodate/show/13915
9. Agak GW, Qin M, Nobe J, Kim MH, Krutzik SR, Tristan GR, et al. Propionibacterium acnes Induces an IL-17 Response in Acne Vulgaris that Is Regulated by Vitamin A and Vitamin D. Journal of Investigative Dermatology. 2014 Feb 1;134(2):366–73.
10. Holick M.F. Vitamin D: extraskeletal health. Rheumatic Disease Clinics. 2012;38(1):141–160.
11. Diane Thiboutot, Andrea L Zaenglein. Pathogenesis, clinical manifestations, and diagnosis of acne vulgaris - UpToDate [Internet]. [cited 2023 Sep 3]. Available from: https://www.uptodate.com/contents/pathogenesis-clinical-manifestations-and-diagnosis-of-acne-vulgaris?search=pathogenesisi%20acne&source=search_result&selectedTitle=1~150&usage_type=default&display_rank=1
12. Bungau SG, Tit DM, Vesa CM, Abid A, Szilagyi DV, Radu AF, et al. Non-conventional therapeutical approaches to acne vulgaris related to its association with metabolic disorders. Eur J Pharmacol. 2022 May 15;923:174936.
13. Thappa DM, Adityan B, Kumari R. Scoring systems in acne vulgaris. Indian J Dermatol Venereol Leprol [Internet]. 2009 May 1 [cited 2023 Sep 9];75(3):323. Available from: https://ijdvl.com/scoring-systems-in-acne-vulgaris/
14. Doshi A, Zaheer A, Stiller MJ. A comparison of current acne grading systems and proposal of a novel system. Int J Dermatol [Internet]. 1997 Jun 1 [cited 2023 Sep 9];36(6):416–8. Available from: https://onlinelibrary.wiley.com/doi/full/10.1046/j.1365-4362.1997.00099.x
15. Liu CW, Tan J. Acne Severity Grading: Determining Essential Clinical Component and Features. Cutaneous Biometrics [Internet]. 2019 [cited 2023 Sep 9];1–8. Available from: https://link.springer.com/referenceworkentry/10.1007/978-3-319-56591-0_22-1
16. Calculator: Body mass index (BMI; Quetelet's index) in adults - UpToDate [Internet]. [cited 2023 Sep 13]. Available from: https://www.uptodate.com/contents/calculator-body-mass-index-bmi-quetelets-index-in-adults
17. Dietary Guidelines for Americans, 2020-2025 | Enhanced Reader.
18. Zhao B, Gan L, Yu K, Männistö S, Huang J, Albanes D. Relationship between chocolate consumption and overall and cause-specific mortality, systematic review and updated meta-analysis. Eur J Epidemiol [Internet]. 2022 Apr 1 [cited 2023 Sep 13];37(4):321–33. Available from: https://link.springer.com/article/10.1007/s10654-022-00858-5
19. Bess Dawson-Hughes. Vitamin D deficiency in adults: Definition, clinical manifestations, and treatment - UpToDate [Internet]. [cited 2023 Sep 3]. Available from: https://www.uptodate.com/contents/vitamin-d-deficiency-in-adults-definition-clinical-manifestations-and-treatment?search=vitamin%20d%20deficiency&source=search_result&selectedTitle=1~150&usage_type=default&display_rank=1#H2
20. Ameen SO, Rasool BQ, Mohammad AN, Tahr SM, Abdulla GN, Omar DA, et al. Prevalence and determinants of vitamin D deficiency amongst patients in Erbil, Kurdistan region of Iraq. Journal of Clinical Medicine of Kazakhstan. 2023 Jun 28;20(3):19–25.
21. van Schoor N, de Jongh R, Lips P. Worldwide vitamin D status. Feldman and Pike's Vitamin D. 2024 Jan 1;47–75.
22. Hasamoh Y, Thadanipon K, Juntongjin P. Association between Vitamin D Level and Acne, and Correlation with Disease Severity: A Meta-Analysis. Dermatology [Internet]. 2022 May 2 [cited 2023 Dec 2];238(3):404–11. Available from: https://dx.doi.org/10.1159/000517514
23. Rasti S, Dewinta N, Kamal R, Adissadah A, Madanny A, Dewanti L. Correlation between Serum 25-Hydroxy Vitamin D Levels and the Severity of Acne Vulgaris: A Systematic Review. Indian J Dermatol [Internet]. 2022 Jan 1 [cited 2023 Dec 2];67(1):31. Available from: /pmc/articles/PMC9154172/
24. Asmaa Awni Haydar. Estimation of serum 25-hydroxy vitamin D and zinc levels in patients with acne vulgaris and their association with disease severity | Request PDF [Internet]. [cited 2023 Dec 3]. Available from: https://www.researchgate.net/publication/344273556_Estimation_of_serum_25-hydroxy_vitamin_D_and_zinc_levels_in_patients_with_acne_vulgaris_and_their_association_with_disease_severity
25. Meixiong J, Ricco C, Vasavda C, Ho BK. Diet and acne: A systematic review. JAAD Int [Internet]. 2022 Jun 1 [cited 2023 Dec 2];7:95–112. Available from: https://pubmed.ncbi.nlm.nih.gov/35373155/
26. Rasool ZS, AKBAY C. Fast Food Consumption Behavior of Consumers in the Northern Region of Iraq. Eurasian Journal of Agricultural Economics (EJAE) [Internet]. 2021 Apr 2 [cited 2023 Dec 3];1(1):1–13. Available from: http://jeae.org/index.php/JEAE/article/view/11

27. Ulvestad M, Bjertness E, Dalgard F, Halvorsen JA. Acne and dairy products in adolescence: results from a Norwegian longitudinal study. J Eur Acad Dermatol Venereol [Internet]. 2017 Mar 1 [cited 2023 Dec 2];31(3):530–5. Available from: https://pubmed.ncbi.nlm.nih.gov/27422392/
28. Aalemi AK, Anwar I, Chen H. Dairy consumption and acne: A case control study in kabul, afghanistan. Clin Cosmet Investig Dermatol [Internet]. 2019 [cited 2023 Dec 3];12:481–7. Available from: http://doi.org/10.2147/CCID.S195191
29. Aghasi M, Golzarand M, Shab-Bidar S, Aminianfar A, Omidian M, Taheri F. Dairy intake and acne development: A meta-analysis of observational studies. Clinical Nutrition. 2019 Jun 1;38(3):1067–75.
30. Ismail NH, Manaf ZA, Azizan NZ. High glycemic load diet, milk and ice cream consumption are related to acne vulgaris in Malaysian young adults: a case control study. BMC Dermatol [Internet]. 2012 Aug 16 [cited 2023 Dec 3];12(1):1–8. Available from: https://link.springer.com/articles/10.1186/1471-5945-12-13
31. Juhl CR, Bergholdt HKM, Miller IM, Jemec GBE, Kanters JK, Ellervik C. Dairy Intake and Acne Vulgaris: A Systematic Review and Meta-Analysis of 78,529 Children, Adolescents, and Young Adults. Nutrients [Internet]. 2018 Aug 9 [cited 2023 Dec 2];10(8). Available from: /pmc/articles/PMC6115795/
32. Bajelan A, Ghaebi M, Javadi M, Barikani A, Beheshti A, Bargahi M, et al. The Association Between the Incidence of Acne Vulgaris and Lifestyle Factors Including Dietary Habits, Physical Activity, and Bathing Frequency. Journal of Skin and Stem Cell 2020 7:3 [Internet]. 2020 Apr 6 [cited 2023 Dec 3];7(3):114161. Available from: https://brieflands.com/articles/jssc-114161.html
33. Daszkiewicz M. Associations between diet and acne lesions. Rocz Panstw Zakl Hig [Internet]. 2021 [cited 2023 Dec 3];72(2):137–43. Available from: http://wydawnictwa.pzh.gov.pl/roczniki_pzh/
34. Conforti C, Agozzino M, Emendato G, Fai A, Fichera F, Marangi GF, et al. Acne and diet: a review. Int J Dermatol [Internet]. 2022 Aug 1 [cited 2023 Dec 3];61(8):930–4. Available from: https://pubmed.ncbi.nlm.nih.gov/34423427/
35. Łożyńska K, Głabska D. Association between Nutritional Behaviours and Acne-Related Quality of Life in a Population of Polish Male Adolescents. Nutrients 2022, Vol 14, Page 2677 [Internet]. 2022 Jun 28 [cited 2023 Dec 2];14(13):2677. Available from: https://www.mdpi.com/2072-6643/14/13/2677/htm
36. Goodarzi A, Roohaninasab M, Behrangi E, Ghassemi M, Ghahremani AP, Teymoori N. Serum parameters, diet and body mass index in acne vulgaris: a mini review. Iranian Journal of Dermatology [Internet]. 2020 Apr 1 [cited 2023 Dec 3];23(1):32–4. Available from: https://www.iranjd.ir/article_108067.html
37. High Body Mass Index is a Risk Factor for Acne Severity in Adolescents: A Preliminary Report - PubMed [Internet]. [cited 2023 Dec 3]. Available from: https://pubmed.ncbi.nlm.nih.gov/31351501/
38. Overview | Acne vulgaris: management | Guidance | NICE.