International Journal of Life Sciences, Biotechnology and Pharma Research Vol. 14, No. 3, March 2025 Online ISSN: 2250-3137
Print ISSN: 2977-0122

DOI: 10.69605/ijlbpr_14.3.2025.109

Original Research

A study of zinc and magnesium in the pathogenesis and severity of acne vulgaris

Dr. Sudeep[1], Dr. Abhilasha[2]

[1]Assistant Professor, Department of Dermatology Venereology & Leprology, NC Medical College and Hospital, Israna, Panipat, Haryana, Sudpgoyat@Gmail.Com
[2]Consultant, Department of Vitreo-Retina Surgery, Eye Q Super-Speciality Eye Hospital, Rohtak, Haryana,Dr.Abhilashadhankhar@Gmail.Com

Corresponding author:
Dr. Sudeep
Assistant Professor, Department of Dermatology Venereology & Leprology, NC Medical College And Hospital, Israna, Panipat, Haryana, Sudpgoyat@Gmail.Com

Received: 16 February, 2025 Accepted: 17 March, 2025 Published: 19 March, 2025

Abstract

Background: Acne vulgaris is a common skin condition that is characterized by cysts, pimples, whiteheads, and blackheads. Though the results have been mixed, recent dermatological research has investigated the role of magnesium (Mg) and zinc (Zn) in acne. This study's objective is to investigate how serum zinc plus magnesium levels in male Indian patients relate to the severity of their acne. Additionally, it compares these levels to those of healthy people in order to determine how they might relate to acne development. **Method:** The comparison analysis was carried out in the department of Dermatology and Venereology at NC Medical College and Hospital, Israna, Panipat, Haryana There were 150 participants in all, 75 of whom had acne vulgaris and 75 of whom were healthy controls. All participants were between the ages of 20 and 35. In order to further categorize the acne patients, three groups were created: mild (25 patients), moderate (25 patients), and severe (25 patients). To determine their possible involvement in acne, serum levels of magnesium (Mg) and zinc (Zn) were assessed together in the patient and healthy subjects. **Results:** Acne subjects (all severities united) and the healthy control group did not significantly differ in their average serum zinc (Zn) plus magnesium (Mg) levels. On the other hand, patients with mild acne ($P = 0.00003$) and those with severe acne ($P = 0.004$) had significantly lower zinc levels. The groups with severe and moderate acne did not differ statistically significantly ($P = 0.78$). Additionally, the magnesium levels of the severe acne group were significantly lower than those of the mild acne group. Conclusion: This study discovered a strong correlation between the severity of acne and serum levels of magnesium and zinc. Zinc supplementation may increase the efficacy of acne treatment in patients with low zinc levels.

Keywords: acne vulgaris, zinc, magnesium

INTRODUCTION

Adolescents are susceptible to acne vulgaris, a persistently inflammatory pilosebaceous unit condition. [1–2] About eighty five percentage of people between the ages of 15 and 18 suffer from this disorder to some extent. [3] Although acne rarely poses a threat to life, its cosmetic consequences can result in permanent physical and psychological scarring. [4] It can lead to social issues at work, school, and home. [4] Acne is a complex condition that depends on a host's inflammatory response, follicular epithelium keratinization pattern, sebaceous follicle colonization, endocrine factors, and genetic predisposition. Certain dietary agents and supplements are known to improve skin health and appearance by increasing skin-level immune function and providing therapeutic bioactive agents that help treat a variety of skin conditions, such as psoriasis, eczema, and acne [5–6]. It is now clearer than ever that dietary factors like vitamins and minerals affect the pathophysiology of acne [7]. A number of factors, including follicular hyperkeratinization, hormone function, Propionibacterium acnes proliferation, elevated sebum production, and inflammation, seem to contribute to the etiology of acne. Despite a large body of scientific literature, the process by which acne lesions form is still not fully understood [8].

Acne treatment is far from ideal. Acne treatment remains a confusing issue. [9] Various methods of therapy that reduce sebum manufacturing, reduce pilosebaceous duct obstruction, reduce bacterial colonization plus modify irritation in host are directed by different pathogenetic mechanisms. [10] With varying degrees of efficacy, systemic treatments have been attempted, including oral antibiotics, 13, cis-retinoic acid, estrogens, and antiandrogens; topical

DOI: 10.69605/ijlbpr_14.3.2025.109

therapy has included benzoyl peroxide, antibiotics, vitamin A acid, sulfur, and salicylic acid. There are benefits and drawbacks to each. Interest in zinc in acne was sparked by its remarkable impact on acrodermatitis enteropathica patient with severe pustular acne.[11] Traces of zinc and magnesium are present in the structures of numerous metalloenzymes that are involved in critical processes like cell division, DNA replication and RNA transcription, and protein synthesis. Thus, zinc is necessary for development plus growth. It is involved in many enzymatic reactions, normal keratogenesis, inflammation regulation, cell membrane stabilization, and delayed-type hypersensitivity reactions. Additionally, zinc affects the activity of numerous hormones and is a structural component of growth hormone, insulin, sex hormones, and thymulin. [12].

Zinc reduces inflammation. Biological membranes and macromolecules are stabilized by zinc. It disrupts the dynamics of the inflammatory process by affecting the phagocytic activity and migration rate of macrophages. [13] Numerous cellular functions are impacted by elevated zinc levels both in vitro and in vivo. [14] Cell wall paralysis, inactivation, and functional immobilization were suggested as explanations for this zinc-induced inhibitory effect. Mast cells, platelets, macrophages, polymorphonuclear cells, and spermatozoa have all been shown to be affected thus far. [14] Mast cells are prevented from releasing histamine by action on cell membranes, which may alter the inflammatory state [14]. Zinc has a negative impact on complement activation and neutrophil chemotaxis. [15] It is now more obvious than ever that the pathophysiology of acne involves nutritional elements like vitamins and minerals [16]. Journals published over the last three decades has shown that individuals with acne have lower zinc (Zn) levels than healthy individuals, and that topical and oral zinc combinations may be beneficial for treatment. [17–18]. It has been suggested that zinc levels are lower than usual in people with acne [19].

Zinc supplementation does not necessarily treat acne, even if a few modest double-blind trials with over 300 participants have reported generally beneficial effects. [20]. Saaiee E et. al., findings showed that, while not statistically significant, thirty individuals with moderate acne vulgaris type II and healthy individuals had different copper and iron contents in their sera. When evaluated to the healthy individual, the Zn content remained unchanged [21]. A recent research by Nasiri et al. found that serum zinc levels were lower in 30 Iranian acne sufferers than in 35 healthy controls, although the difference was not statistically significant (P=0.32) [22]. In order to compare the blood levels of zinc and magnesium in male Indian patients with acne vulgaris to those of healthy subjects, this study was conducted.

Methods: The study incorporated 75 clinically confirmed cases of acne vulgaris and 75 controls that were seen at the Medical College's Dermatology Outpatient Department at NCMC&H in Israna, Panipat, Haryana. There were 150 male participants in the study, with ages ranging from 20 to 35 (mean ± SD; 21.82 ± 3.77 years). Based on the severity of their acne, the patients were split up into three groups. Three patient groups were identified: twenty-five had mild acne, twenty-five had moderate acne, and twenty-five had severe acne. The following guideline was used to score the severity of acne:

- Mild acne is characterized by a count of fewer than 10 papules and fewer than 20 pustules.
- Moderate acne is characterized by a papule count of 10 to 30 and a pustule count of 20 to 40.
- Severe acne: When the number of pustules exceeds 40 and the number of papules exceeds 30 [23].

Inclusion criteria: The study included untreated clinically diagnosed male patients with acne vulgaris alone. This study includes patients who provided their informed permission.

Inactive instances of Acne vulgaris that have received treatment are excluded.

Figure no.1: acne vulgaris

DOI: 10.69605/ijlbpr_14.3.2025.109

Sample collection: Samples of fasting blood were taken after consent was obtained. Each patient and control male had 5 ml of peripheral venous blood drawn into plain vials, permitted to form a clot, and thereafter centrifuged for 10 minutes at 2500 rotation per minutes. Prior to mineral assay, the separated serum was kept at -20°C. Zinc and magnesium levels in the serum were measured using Earba 200E.

Statistical Analysis: The experimental data were expressed as mean ± standard deviation. Using SPSS-2023 and the Student's t-test, the significance of the differences between the treatments and corresponding controls was examined.

Result: This study contrasted a number of traits between acne patients and the healthy subjects. Acne patients' average age was 27.4 ± 4.3 years, which was significantly younger than the healthy subjects of age of 29.32 ± 4.2 years. The statistical significance of this difference was demonstrated by the t-value of 2.76 and the p-value of 0.006. With a mean BMI of 23.6 ± 4.7 kg/m² for the control group and 23.4 ± 4.4 kg/m² for the acne patients (t-value = 0.26, p-value = 0.788), the two groups BMIs did not significantly differ from one another. Serum zinc levels in acne patients were substantially lower than those in the control group (101.8 ± 6.6 mg/dl versus 104.3 ± 7.3 mg/dL on average). The statistical significance of this difference was demonstrated by the t-value of 2.2 and the p-value of 0.029. Similarly, acne patients had considerably lower serum magnesium levels (1.05 ± 0.15 mg/dl,) than the control group (1.12 ± 0.16 mg/dl,), with a t-value of 2.7 and a highly significant p-value of 0.006.

Table 1: Showing the biochemical and clinical information for both acne vulgaris patients and healthy male subjects

Characteristic	Control (n=75) mean ± SD	Acne patients (n=75) mean ± SD	t-value	p-value
Age (years)	29.32±4.2	27.4±4.3	2.76	0.006
BMI(Kg/m^2)	23.6±4.7	23.4±4.4	0.26	0.788
Zn(mg/dl)	104.3±7.3	101.8±6.6	2.2	0.029
Mg(mg/dl)	1.12±0.16	1.05±0.15	2.7	0.0006

Figure no. 2: Showing the Clinical and biochemical information for individuals with acne vulgaris and healthy male controls (mean)

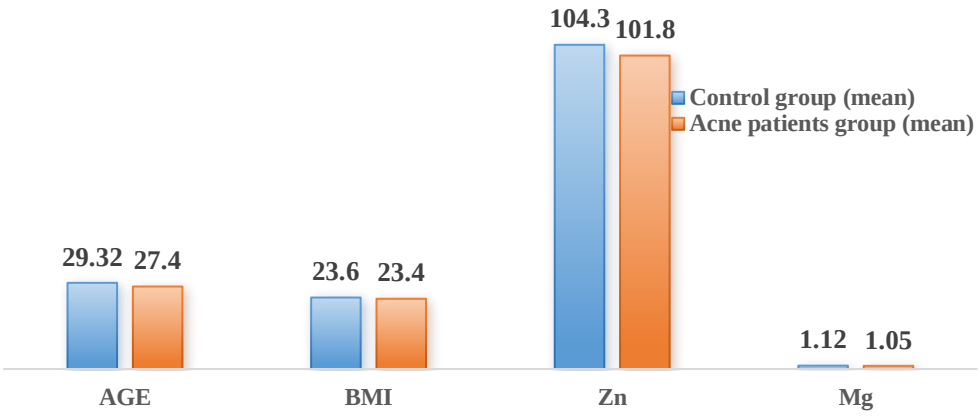


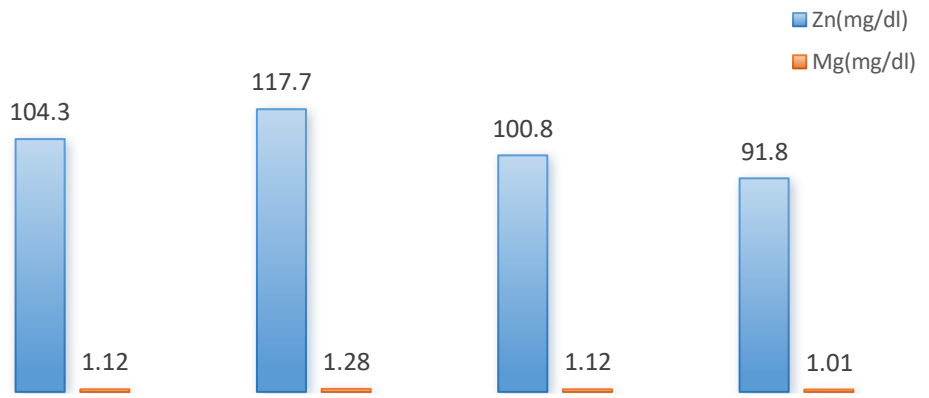
Table 2: Showing the concentrations of zinc and magnesium in the serum of patients with mild, moderate, and severe acne vulgaris as well as healthy controls.

Parameters	Controls (n=75)	Mild acne (n=25)	Moderate acne (n=25)	Severe acne (n=25)
Zn	104.3±7.3	117.7±8.3	100.8±10.1	91.8±13.03
Mg	1.12±0.16	1.28±0.16	1.1±0.1.5	1.01±0.17

In comparison to controls (104.3 ± 7.3 mg/dL and 1.12 ± 0.16 mg/dL), patients with mild acne had the highest serum zinc and magnesium levels (117.7 ± 8.3 mg/dL and 1.28 ± 0.16 mg/dL, respectively). The lowest values were found in patients with severe acne (91.8 ± 13.03 mg/dL for zinc and 1.01 ± 0.17 mg/dL for magnesium), but levels declined as acne severity increased. This suggests an inverse relationship between mineral levels and acne severity.

DOI: 10.69605/ijlbpr_14.3.2025.109

Figure no.3: Showing the Serum zinc and magnesium concentration mean values in patients with mild, moderate, and severe acne vulgaris and healthy controls.



Discussion:

One of the most prevalent cutaneous conditions, acne vulgaris is characterized by cysts, papules, pustules, and comedones. A number of factors, including follicular hyperkeratinization, hormone function, Propionibacterium acnes proliferation, elevated sebum production, and inflammation, seem to contribute to the etiology of acne. Normal pubertal growth and epithelial differentiation depend on zinc, a trace element. It is abundant in the skin, particularly in the epidermis [24]. The significant improvement in acrodermatitis enteropathica after taking zinc supplements has demonstrated its significance for human metabolism. Zinc treatment was also found to completely resolve severe acne in a case of acrodermatitis enteropathica [25].

The current investigation found that although acne sufferer had serum zinc levels lower than those of male controls, the difference was not statistically significant. This outcome is consistent with Nasiri et al. [26], who discovered a negligible drop in serum zinc levels in their investigation that revealed severe acne had significantly lower serum zinc levels than mild, moderate, and healthy control acne. These findings are consistent with those of Michaelsson et al. and Amer et al. [27–28], who demonstrated that male patients with severe acne had notably lesser serum zinc concentration than controls. According to these authors, the positive results of oral zinc treatment observed in clinical practice may be explained by the less serum zinc concentration of patients with severe acne [28].

Zinc nutritional status is crucial for oil gland activity, local skin hormone action, wound repair, inflammation regulation, and skin cell regeneration. Numerous cases of acne have been successfully treated with zinc supplements [29]. Research has shown that most people only get 8–9 mg of zinc/day from their diet, while the recommended daily allowance (RDA) for adults is 15 mg [30]. Zinc deficiency is a recipe for acne, according to a review published by Dr. Preston [31]. Zinc is an element that reduces inflammation may be involved in pathophysiology of acne, according to Nasiri et al.'sstudy,and more research is necessary [26].

Additionally, the current study discovered that patients having severe acne had significantly lower serum magnesium concentration than those with mild or moderate acne. In all bodily tissues, the synthesis of proteins and enzymes depends on this element (Mg). This contains the proteins and enzymes found in skin cells, which are continuously dividing. Additionally, it is totally necessary for correct utilization of the vitamin pyridoxine [31]. According to review of literatures, it is imperative to take supplements containing roughly 500 mg of this mineral daily.

The mammalian target of rapamycin (mTOR) protein, a serine/threonine kinase that directs protein translation through a rapamycin-sensitive pathway, rests on elements. To govern cellular growth, mTOR integrates signals from mitogens, glucose, and amino acids. Lynch et al. found that Zn^{2+} enhances but is not essential for mTOR activity, with maximal stimulation at ~100 µM and inhibition at higher concentrations. Other divalent cations had no effect in the presence of excess Mg^{2+}. Zinc also influences amino acid and insulin signaling, potentially enhancing insulin and nutritional pathways. Saleh's study reported elevated GH and IGF-1 levels in male Iraqi acne patients, particularly those with severe acne, which may stimulate androgen synthesis, sebocyte proliferation, and acne exacerbation. Savastano et al. highlighted that spleen enlargement, a marker of chronic inflammation, significantly impacts the IGF-I/IGFBP-3 share more than hepatic steatosis alone. They also found a negative correlation between IGF-I components and fat mass percentage, insulin insensitivity, and hepatic steatosis severity, with fat mass being a stronger relevant factor of IGF-I and IGFBP-1 than hepatic steatosis [32-34].

DOI: 10.69605/ijlbpr_14.3.2025.109

This study included patients with milder inflammatory acne. According to our research, the serum zinc levels of acne patients were statistically significantly lower than those of the control group. which is consistent with earlier research. Zinc deficiency in acne sufferers has been linked to increased excretion through sweat or feces, decreased absorption, dieting patients, and nutritional deficiencies. Another factor lowering serum zinc levels in acne patients is the inflammatory response [27]. It is unknown, nevertheless, how zinc deficiency in the epidermis results in acne or how crucial it is for inflammatory acne. Zinc's anti-inflammatory properties as well as its effects on vitamin A and androgen metabolism may be the cause of the likely correlation between zinc and acne [35]. The most significant mechanism pertaining to acne is the impact of zinc on inflammatory cells, particularly granulocytes [36]. Zinc has anti-inflammatory properties, stabilizes macromolecules and lysosomes, speeds up neutrophil chemotaxis and complements activation, and regulates phagocytosis and bactericidal activity [35–36]. Zinc inhibits mast cell histamine secretion and prevents inflammatory phenomena, according to studies conducted on lab animals [37]. Since zinc is essential for the production of retinol-binding protein (RBP), which carries vitamin A and inhibits keratinization and follicular blockage, Acne may develop as a result of Zinc malnutrition. By preventing the reductase enzyme from converting testosterone to DHT, zinc also controls the synthesis of androgens. Perhaps as a result of poor nutrition, Serum zinc levels were significantly lower in acne sufferers than in controls, according to our study. Treatment success may be improved by measuring serum zinc levels in acne patients and giving supplements to those who are deficient [38, 39].

Conclusion: The severity of acne was found to be significantly correlated with both zinc plus magnesium concentration in the current study. It is necessary to conduct more research on the serum concentration of magnesium plus zinc in patients with severe acne. The severity of acne was found to be significantly correlated with the levels of zinc and magnesium.

Reference

1. Andrea LZ, Emmy MG. Acne vulgaris and acneiform eruptions. In: Lowell A, Stephen I, Barbara A, editors. Dermatology in general medicine. 8th ed. NewYork: McGraw Hill; 2012: 897-900
2. Alisson ML, Anne E. Acne. In: Christopher EM, Jonathan B, editors. Textbook of dermatology. 9th ed. UK: Wiley; 2016;20:1-2
3. Cunliffe WJ, Claydon AD. Acne vulgaris is the etiology and treatment. Clin Exp Dermatol. 1981;6:461-3.
4. Tolman EL. Acne and acneform dermatoses. In: Moschella S, Hurley J, editors. Dermatology. 2nd ed. Philadelphia: Saunders; 1985: 1306-1321.
5. Aesoph, Lauri M. (2018). A holistic approach to skin protection. Nutrition Science News 3: 204-208.
6. Boelsma E, Hendriks HF, Roza L (2021). Nutritional skin care: health effects of micronutrients and fatty acids. Am J Clin Nutr 73: 853-864.
7. Katzman M, Logan AC (2017) Acne vulgaris: nutritional factors may be influencing psychological sequelae. Med Hypotheses 69: 1080-1084.
8. Vora S, Ovhal A, Jerajani H, et al. Correlation of facial sebum to serum insulin-like growth factor-1 in patients with acne. British J of Dermatology 2008; 159:990-991.
9. Fulton JE. Acne-pathogenesis and treatment. Postgrad Med. 1972;52:85-9.
10. Adhoc committee report of the national program for dermatology, Systemic antibiotics for treatment of acne vulgaris. Arch Dermatol. 1975;111:1630-6.
11. Chvapil E. Effect of zinc on cells and biomembranes. Med Clin N Amer. 1976;60:779-81.
12. Rackett SC, Rothe MJ, Grant- Kels JM. Diet and dermatology. J Am Acad Dermatol 1993; 29: 447- 461. PMID: 8349862
13. Michaelsson G. Oral zinc in acne. Acta Dermatol Venereol. 1980;60:87.
14. Weissman K, Wadskov S, Sordergaard J. Oral zinc sulfate therapy in ace vulgaris. Acta Dermatol Venereal. 1977;57:357-60.
15. Weston WL. Zinc correction of defective chemotaxis in acrodermatitis enteropathica. Arch Dermatol. 1977;113:422-5.
16. Valquist A, Michaelson G. Acne treatment with oral zinc and vitamin A: Effect on serum levels of zinc and retinol-binding proteins. Acta Dermatol Venereol. 1978;58:437-40.
17. Katzman M, Logan AC. Acne vulgaris: nutritional factors may be influencing psychological sequelae. Med Hypotheses 2007; 69: 1080-1084.
18. Dreno B, Foulc P, Reynaud A, et al. Effect of zinc gluconate on propionibacterium acnes resistance to erythromycin in patients with inflammatory acne: in vitro and in vivo study. Eur J Dermatol 2005; 15: 152-155.
19. Pohit J, Saha KC, Pal B. Zinc status of acne vulgaris patients. J Appl Nutr 1985; 37; 18- 25.
20. Verma KC, Saini AS, Dhamija SK. Oral zinc sulfate therapy in acne vulgaris: a double-blind trial. Acta Derm Venereol 1980; 60: 337-340.
21. El-Saaiea L, Abdel-Aal H, El-Mahdy H, and Abdel-Aal AM. Serum copper, iron, and zinc in cases of acne vulgaris. J Med 1983; 14(2): 125-136.
22. Nasiri S, Ghalamkarpour F, Yousefi M, and Sadighha A. Serum zinc levels in Iranian patients with acne. Clinical and Experimental Dermatology 2009; 34:pp e446.
23. Toyoda M., Morohashi M. (2011). Pathogenesis of acne. Med Electron Microsc 34: 29-40.
24. Bilen N. Vitamins, trace elements, and essential fatty acids in skin diseases. T Klin J Dermatol 1998; 8: 116-120.
25. Michaelsson G, Vahlquist A, Juhlin L. Serum zinc and retinol-binding protein in acne. Br J Dermatol 1977; 96; 283-286. PMID: 139912
26. Nasiri S, Ghalamkarpour F, Yousefi M, Sadighha A (2009) Serum zinc levels in Iranian patients with acne. Clin Exp Dermatol 34: e446.
27. Michaëlsson G, Vahlquist A, Juhlin L (1977) Serum zinc and retinol-binding protein in acne. Br J Dermatol 96: 283-286.

DOI: 10.69605/ijlbpr_14.3.2025.109

28. Amer M, Bahgat MR, Tosson Z, Abdel Mowla MY, Amer K (1982) Serum zinc in acne vulgaris. Int J Dermatol 21: 481-484.
29. The Doctors? Vitamin and Mineral Encyclopedia (S. Hendler). Simonand Schuster, 1990: 195-207 (zinc).
30. Nutrition for Living (1988) (2ndedn), The Benjamin/Cummins Publishing Companies; 338.
31. Preston R (2002) Acne-how to prevent and overcome acne forever. International Institute of Nutritional Research.
32. Lynch CJ, Patson BJ, Goodman SA, Trapolsi D, Kimball SR (2001) Zinc stimulates the activity of the insulin- and nutrient-regulated protein kinase mTOR. Am J Physiol Endocrinol Metab 281: E25-34.
33. Saleh BO (2012) Role of growth hormone and insulin-like growth factor-I in hyperandrogenism and the severity of acne vulgaris in young males. Saudi Med J 33: 1196-1200.
34. Savastano S, Di Somma C, Pizza G, De Rosa A, Nedi V, et al. (2011) Liverspleen axis, insulin-like growth factor-(IGF)-I axis and fat mass in overweight/ obese females. J Transl Med 9: 136.
35. Igic PG, Lee E, Harper W, Roach KW. Toxic effects associated with consumption of zinc. Mayo Clin Proc 2002; 77: 713-716. PMID: 12108610.
36. Dreno B. Topical antibacterial therapy for acne vulgaris. Drugs 2004; 64: 2389-2397. PMID: 15481998.
37. Lennard ES. Implications in the burn neutrophil of serum and cellular zinc levels. J Surg Research 1980; 29: 75-82. PMID: 7421182.
38. Smith JE, Brown ED, Smith JC. The effect of zinc deficiency on the metabolism of retinol-binding protein in the rat. J Lab Clin Med 1974; 84: 692- 697. PMID: 4283791
39. Fitzherbert JC. Acne vulgaris-zinc deficiency. MedJ Aust 1976; 1: 848. PMID: 34246