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Original article

EVALUATION OF VITAMINS (A, C, D, E) LEVELS IN PSORIASIS PATIENTS IN BASRAH, IRAQ

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Abstract

Background. Psoriasis is a persistent inflammation that leads to an excessive growth of cells. Vitamins are crucial for maintaining the health of the skin.

Purpose. Study the relationship between vitamins and psoriasis.

Methods. A randomized clinical trial was carried out in Basrah , Iraq. Specimens were obtained from the Al-Faihaa Hospital and the Basrah Teaching Hospital. The analytical sample consisted of 45 individuals diagnosed with psoriasis and 45 persons who were in good condition. Their data were collected based on age, gender, disease severity, treatment, and geographical area, we conducted an analysis of the samples using several ELISA device measurements.

Results. The study revealed notable disparities in the levels of vitamin C and vitamin D, with statistically significant differences at a significance level of $p<0.001$. Additionally, there was a significant difference in the levels of vitamin E, with a significance level of $p<0.01$. The data did not indicate any variations in vitamin A levels, save for a discrepancy based on geographical location. The findings indicated a decline in vitamin E levels among male patients and a reduction in vitamin D levels among female patients. There is a positive relationship between the variables C, E and C, D. The results did not indicate any impact on the concentration of vitamins based on the severity of the condition and the method of treatment.

Conclusions. It is imperative to administer vitamins (C, D, and E) to individuals with psoriasis, in order to prevent the exacerbation of symptoms and the development of other ailments.

Keywords: Psoriasis; Retinol; Ascorbic Acid; Calciferol Alphatocopherol

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1. Introduction

Psoriasis is an inflammatory skin disease classified as a genetic disease [1; 2]. This disease is characterized by the appearance of red, inflamed areas with white scales of dead cells floating on them. The observer perceives it as if the skin, which covers the body to protect it from external conditions, has disintegrated and is unable to perform its function. It has been exposed to deterioration in its physiological, formal, and functional characteristics.

Since the skin is the largest organ in the body, its functions are necessary for internal balance. It is concerning that the incidence of psoriasis worldwide is 1–2% [3]. The number of people affected is estimated at about 60 million worldwide [4]. What is even more concerning is the incapacity of doctors and scientists to effectively treat this disease and understand its underlying causes, given the multitude of potential causes [5].

Psoriasis has been associated with cardiovascular disease and a network of interrelated diseases [6]. It is believed that physical activity, nutritional management, and reducing smoking and alcohol can improve the condition [7]. The World Health Organization estimates that more than 2 billion people worldwide suffer from a deficiency in essential vitamins and minerals [8], highlighting the importance of vitamins in skin health and repair and their antioxidant role in combating oxidative stress [9].

We decided to estimate the level of vitamins (A, C, D, and E) in the serum of psoriasis patients and compare them with the control group. As research and studies have shown, fat-soluble vitamin A (retinol) is essential for human immune function and is used as a treatment for some skin diseases. Its deficiency leads to a variety of symptoms.

A Far Eastern study revealed that a vitamin A deficiency causes hyperkeratosis in the skin [10]. Researchers conducted a study on mice, depriving them of vitamin A, but their findings revealed that the mitochondrial system remained unaffected. Individual cell studies indicated that the first morphological evi-

dence of vitamin deficiency would be in the nucleus [11], but what interests us among the symptoms is that its deficiency leads to dryness and poor wound healing [12].

On the other hand, the study included an assessment of vitamin C (ascorbic acid), which has an effect on repairing and improving skin elasticity [13]. Heart failure and pulmonary hypertension have been associated with unintentional vitamin C deficiency in humans [14]. It also maintains collagen levels and skin cohesion [15]. Some researchers have claimed that it is one of the antioxidants that strengthens immunity and protects it from cancer cell formation [16; 17].

Regarding the evaluation of vitamin E (tocopherol), it is soluble in fat, reduces the risk of certain heart diseases, and aids in the strength and vitality of T-cell membranes and their proper reproduction [18]. Additionally, it enhances the health of blood vessels [19] and collaborates with vitamin C through a known mechanism to combat free radicals in the body [20].

As for our choice of vitamin D (calciferol), this vitamin is important for skin health and hydration and protects it from the sun's heat, as it plays a pivotal role in skin balance by activating the vitamin D nuclear receptor, contributes to its function as a barrier, and is considered an essential part of the immune system [21]. It has the ability to control infection and reduce inflammation [22].

A study compared the antioxidant capacity of vitamin D with that of the anti-cancer drug tamoxifen and its receptor 4-hydroxy (structural mimics of cholesterol) and discussed it in relation to the anti-cancer action [23] of this vitamin. The study aims to estimate the levels of the aforementioned vitamins in order to determine whether patients with psoriasis have a deficiency and whether it is considered one of the causes of the disease's exacerbation.

2. Materials and Methods

1.2. Study sample

The College of Education for Pure Sciences, Department of Biochemistry, Basrah, Iraq, conducted this study from March 2024 to July 2024. In order to accomplish this goal, we selected a sample of 90 participants, consisting of 45 psoriasis patients as cases and 45 healthy individuals as controls, ensuring that the two groups were age and gender matched. Psoriasis patients frequently visit the dermatology clinic in both Al-Faihaa Teaching Hospital and Basra Teaching Hospital for consultations or routine check-ups.

2.2. Exclusion criteria

Patients with hypertension, diabetes, liver, kidney, tumor, heart disease, and thyroid diseases were excluded. Patients younger than 13 and older than 70 years

were excluded. In the morning at the hospital, patients and controls were asked to fill out a questionnaire containing their demographic data, i.e., age, gender, dermatologist-determined severity, treatment type, and geographical location.

2.3. Sample collection

After drawing three milliliters of venous blood by syringe, the blood sample was placed in tubes containing a clotting-inducing gel. After leaving the tubes for half an hour, we transferred them to a centrifuge running at 3000 rpm for 10 minutes. We divided the serum into five groups, placed each in a Bendorf tube, and frozen the tubes at -20°C pending analysis to prevent the serum from thawing again.

2.4. Laboratory tests

We measured the concentrations of retinol (vitamin A), ascorbic acid (vitamin C), calciferol (vitamin D), and alpha-tocopherol (vitamin E) using a human-adaptable ELISA kit provided by Shanghai Ideal Medical Technology [24]. Furthermore, we measured the absorbance at 450 nm and constructed a standard curve of optical density (OD) versus concentration using the dilutions specified in each kit's vial. We then measured the concentrations of the obtained samples against the standard curve, which has an assay-specific detection range.

2.5. Statistical analysis

The present study used SPSS version 25 for statistical analysis. We followed descriptive statistics such as mean, standard deviation (SD), and percentages. We used Pearson's correlation coefficient to evaluate the correlation coefficient (r value), and thus a significance of less than 0.05 was considered as the significance threshold.

3. Results

Table 1 presents the demographic results and chemical variables for both patients and healthy individuals. It indicates that there are no significant differences in the average ages and gender distribution between the two groups. Additionally, there are no significant differences in the levels of vitamin A. Nevertheless, the findings demonstrated remarkably substantial disparities between them, with a significance level of $p<0.001$ observed in both vitamin C and D. However, the disparity dropped to $p<0.01$ in the case of vitamin E.

Upon analyzing the data in Table 2, it is evident that there is no statistically significant relationship between vitamin A and the magnitude of change across different age groups. The results indicate that the level of vitamin C varies with increasing age, as seen by variations at significance levels of $p<0.001$ and $p<0.01$. However, there were no significant differences in the levels of vitamin D and E, except for individuals under the age of 20. The findings indicate a pro-

nounced and statistically significant decline in vitamin D levels among patients, with a significance level of $p<0.001$. Additionally, there is a fall in vitamin E levels among individuals aged 21-30 years, with a significance level of $p<0.01$.

Table 1.

Demographic data and biochemical variables under study for study participants

Variables		Mean±Std.Deviation		*p*-value*
		N=45 controls	N=45 patients	
Age (years)		32.910±12.236	33.710±13.507	NS
Gender	Male	19(42.2%)	24(53.3%)	NS
	Female	26(57.7%)	21(46.6%)	NS
Vit A (100-1600nmol/L)		179.503±905.691	174.509±969.539	NS
80 -5)µmol/l		3.657±24.964	3.443±164.891	0.000
VitD (75-1200) µg/L		94.729±250.446	36.057±164.891	0.000
VitE (50-800) nmol/L		136.126±585.224	137.155±449.119	0.003

Table 2.

Level of variables in the subjects according to age

Variables		Mean±Std.Deviation		*p*-value*
		Patients N=45	Controls N=45	
Vit A (100-1600nmol/L)	<20	28.393±794.121	106.479±971.986	NS
	21-30	877.624±184.953	225.113±943.335	NS
	31-40	219.133±923.988	154.258±950.791	NS
	41-50	80.731±959.855	138.408±1004.935	NS
	>50	80.731±915.037	242.315±1013.783	NS
Vit C (5-80) µmol/l	<20	5.088±28.242	2.936±16.895	0.000
	21-30	4.176±23.685	3.132±15.703	0.000
	31-40	2.410±25.651	3.776±18.919	0.000
	41-50	1.995±23.947	3.137±17.118	0.005
	>50	3.502±24.200	3.793±15.296	0.002
VitD (75-1200) µg/L	<20	28.461±367.259	36.543±167.696	0.000
	21-30	18.210±206.430	92.231±165.626	NS
	31-40	111.629±248.229	35.812±164.973	NS
	41-50	1.156±154.656	33.549±155.383	NS
	>50	1.168±183.171	35.351±170.987	NS
VitE (50-800) nmol/L	<20	123.416±576.281	156.084±371.259	NS
	21-30	140.738±729.106	162.934±412.584	0.01
	31-40	77.059±565.292	66.260±484.953	NS
	41-50	4.329±724.780	85.919±556.365	NS
	>50	156.554	88.316±409.623	NS

Upon examining (Table 3), it is evident that when the groups are divided by gender in all participants, there is no discernible disparity between males and females in terms of vitamin A. However, there are notable and highly significant variations in favor of healthy individuals in the level of vitamin C, with a statistical significance level of *P<0.001*. Vitamin D levels increase significantly in healthy females at a level of *P<0.01,* while vitamin E levels increase significantly in healthy males at a level of *P<0.05*.

Table 3.

Level of variables in the study community according to gander

Variables		Mean±Std.Deviation		*p*-value*
		Controls N=45	Patients N=45	
Vit A (100-1600) nmol/L)	Male	160.012±972.716	163.387±977.640	NS
	Female	178.475±847.806	191.925±958.739	NS
Vit C (5-80) µmol/l	Male	3.032±23.141	3.679±16.458	0.000
	Female	3.541±26.297	3.112±17.372	0.000
Vit D (75-1200) µg/L	Male	140.737±249.835	37.907±170.483	NS
	Female	82.811±250.708	32.848±156.505	0.007
VitE (50-800) nmol/L	Male	160.098±641.385	143.459±454.796	0.022
	Female	166.353±545.578	130.273±439.893	NS

(Table 4) displays the patient groups separated by gender, and the findings indicate that there are no notable disparities in any of the factors.

Table 4.

Level of variables in the study population by gender in the patient group

Variables	Mean±Std.Deviation		*p*-value*
	Female (21)	Male (24)	
Vit A (100-1600) nmol/L)	163.387±977.640	191.925±958.739	NS
5-80) µmol/l) Vit C	3.679±16.458	3.112±17.372	NS
Vit D (75-1200) µg/L	37.907±170.483	140.737±156.505	NS
VitE (50-800) nmol/L	143.459±454.796	130.273±439.893	NS

The findings shown in Table 5 indicate that there were no statistically significant variations in any of the variables when examining the disease severity among patients categorized into three groups: mild, moderate, and severe. 8 individuals exhibited mild psoriasis, whereas 15 individuals had moderate psoriasis, and 22 individuals experienced severe psoriasis.

Table 5.

Level of study variables according to disease severity

Variables		Mean ± SD	*p*-value*
Vit A	Mild	87.447±967.169	NS
	Moderate	235.013±991.864	
	Severe	148.998±954.517	
Vit C	Mild	3.327±15.737	NS
	Moderate	3.276±16.632	
	Severe	3.470±17.799	
Vit D	Mild	32.341±144.981	NS
	Moderate	40.175±156.557	
	Severe	31.721±177.685	
Vit E	Mild	22.335±499.148	NS
	Moderate	146.107±418.339	
	Severe	148.231±456.810	

Based on the treatment outcomes, it was observed that 23 patients were administered topical therapies, whereas 22 patients were given biological treatments. No substantial disparities were observed between patients utilizing topical therapies and patients utilizing biological treatment, as evidenced in Table 6.

Table 6.

Level of studied variables by location

Variables	Mean±Std.Deviation		*p*-value*
	City center (24)	City outskirts (21)	
Vit A (100-1600) nmol/L)	150.121±1026.432	177.820±887.046	0.005
5-80) µmol/l) Vit C	3.685±16.111	2.810±17.920	NS
Vit D (75-1200) µg/L	35.389±172.433	35.488±153.579	NS
VitE (50-800) nmol/L	151.241±437.648	120.499±463.004	NS

According to Table 7, the study found that there were 20 participants from the countryside and 25 participants from the center when comparing the geographical location of the patients' residents. The rural population had significantly greater levels of vitamin A, with a significance level of $P<0.01$. No significant differences were observed in the other variables analyzed.

Table 7.

Level of studied variables according to treatment type

Variables	Mean±Std.Deviation		*p*-value*
	Topical treatment	Biological treatment	
Vit A (100-1600) nmol/L)	200.479±957.929	146.003±981.634	NS
Vit C (5-80) µmol/l	3.899±17.295	2.904±16.386	NS
Vit D (75-1200) µg/L	127.209±439.376	137.155±449.119	NS
VitE (50-800) nmol/L	37.389±154.628	33.432±173.872	NS

The statistical study examined the correlation coefficient between the variables A, C, D, and E, and the influencing factors listed in Table 8. The results indicated a significant positive relationship between vitamins C, D, and E, and the gender and age factors, with significance levels of *P<0.001* and *P<0.01*, respectively. No other correlations were found among the remaining factors, except for a negative correlation between vitamin A and geographical location, with a significance level of *P<0.01*.

Table 8.

Pearson correlation coefficient for biochemical variables and other relevant variables

Variables	Age		Gender		Severe		Type of treatment		Location	
	r-value	*p*-value*	r-value	*p*-value*	r-value	*p*-value*	r-value	*p*-value*	r-value	p-value*
Vit A	0.140-	NS	0.243-	0.02	0.055-	NS	0.069	NS	0.397-	0.005
Vit C	0.652	0.000	0.763	0.000	0.257	NS	0.133-	NS	0.261	NS
Vit D	0.391	0.013	0.473	0.002	0.356	NS	0.271	NS	0.261-	NS
Vit E	0.375	0.002	0.301	0.017	0.034-	NS	0.079	NS	0.164	NS

Table 9.

Pearson's correlation coefficient for vitamins

Variables	Vit A		Vit C		Vit D		Vit E	
	Correlation coefficient	*p*-value*	Correlation coefficient	*p*-value*	Correlation coefficient	*p*-value*	Correlation coefficient	*p*-value*
Vit A	1	-	0.136-	NS	0.029-	NS	0.028	NS
Vit C	0.136-	NS	1	-	0.489	0.001	0.292	0.02
Vit D	0.29-	NS	0.489	0.001	1	-	0.214	NS
Vit E	0.028	NS	0.292	0.02	0.214	NS	1	-

(Table 9) displays the correlation coefficient results, indicating a positive relationship between vitamin C and vitamin D at a significance level of $P<0.001$, as well as between Vitamin C and vitamin E at a significance level of $p<0.05$. However, there is no relationship observed between vitamin A and the other variables.

4. Discussion

Psoriasis is a chronic inflammatory skin disease with autoimmune features. The development of this disease has been linked to dysfunction in cell functions and balance, which causes a pro-inflammatory systemic environment and the emergence of many disorders. This study evaluated the levels of vitamins (A, C, D, and E) and found no significant differences in vitamin A levels between patients and healthy individuals. However, a previous study suggested that the concentration of vitamin A in psoriasis patients could predict the development of fungal infections [25].

Many studies report that psoriasis patients have vitamin A deficiency. For instance, a 1985 study examined the vitamin A status of 107 psoriasis patients and 37 healthy individuals. Psoriasis patients used retinol to improve their skin [26]. Many researchers proposed that psoriasis-affected skin may alter retinol metabolism [27].

All age groups and genders had very low vitamin C levels compared to healthy people, which aligns with a study that found psoriasis patients consume vitamin C rapidly [28]. Another study reported that psoriasis patients suffer from a deficiency in vitamin C [29]. A study in Najaf Governorate, Iraq, showed that there is a positive relationship between vitamin C and a decrease in the level of malondialdehyde in psoriasis patients [30]. This suggests that psoriasis patients face a threat from a deficiency in vitamin C, an antioxidant that safeguards the heart, blood vessels, and skin collagen.

Psoriasis patients face severe threats from a range of diseases, including cancer, oxidative stress, and programmed cell death. The results also show significant differences in vitamin D between patients and healthy people, and the difference increases between age groups under twenty years. Our study agreed with many studies, whether on psoriasis or on autoimmune diseases, which are within the context of our study, that vitamin D is low in psoriasis patients [31; 32]. Studies have demonstrated that a deficiency in this vitamin can potentially lead to other bone-related diseases. The causes of vitamin D deficiency in these individuals may include inadequate sun exposure and drug therapy that interferes with its absorption. In fact, the main sources of vitamin D are the sun

and food; therefore, a decrease or absence of one of them may have an effect on its deficiency [33].

Inactive forms of vitamin D, such as ergocalciferol, known as vitamin D2, and cholecalciferol, or vitamin D3, come from plants or vegetables and animal species [34; 36]. As for the lack of a difference in age groups older than 20 years, it comes with the increasing interest of patients in taking nutritional supplements at this age. We found that there are significant differences between female patients and healthy females in vitamin D deficiency, and there are no differences between males. Another study, which evaluated vitamin D levels, found a significant decrease in female psoriasis patients compared to healthy ones, but no significant difference in males [37,38]. Given the prominent role of vitamin D in regulating calcium and phosphate levels, its deficiency means that female psoriasis patients are more susceptible to osteoporosis [39]. The effect of vitamin D on hormones may explain this deficiency. According to one study, the active form of vitamin D stimulates the production of progesterone by 13%, estrogen by 21%, and estradiol by 9% in cultured human ovarian cells [40]. A recent study revealed that vitamin D deficiency is one of the causes of exposure to Alzheimer's disease [41].

Our results showed significant differences in vitamin E between patients and healthy subjects and that there were fluctuations in the concentration level between age groups, with the most significant differences appearing at the age of (21-30). Our results were consistent with a study that showed vitamin E deficiency in patients suffering from psoriasis and vitiligo [42]. Another study on the nutrition of psoriasis patients recommended taking vitamins because they have a deficiency in their concentration levels [43]. Researchers treated psoriasis patients with selenium and vitamin E, revealing that antioxidants alone cannot significantly alter clinical conditions, except in mild cases, and it's better to combine them with drug treatments for improved outcomes [44]. Our apparent results indicated that vitamin E levels are higher in healthy males than in sick males, and there are no differences between females, indicating that sexual efficiency is somewhat weak in sick males [45]. This is based on a study and information indicating that vitamin E enhances sexual efficiency in men [46].

The study showed no significant differences in all concentrations of the studied variables of vitamins according to the geographical location factor, except for vitamin A, which was higher in patients living in the countryside than in patients living in the center. We discovered that they eat leafy vegetables such as basil, mint, and radish, as well as dairy products on a daily and continuous basis, after communicating with them. This type of nutrition differs from that of residents in the center, as they tend to eat more processed products [47].

Studies have demonstrated that vegetables and dairy products contain vitamin A [48]. Studies and international opinion indicate the maximum permissible level of vitamin A [49]. As for the type of treatment and severity of the disease, the results showed no significant differences in vitamin levels. These results agreed with another study [50]. This result provides important evidence that vitamin deficiency is not affected by treatment and disease severity, but rather means that the imbalance in vitamin levels in psoriasis patients is inherent in the mechanism of cell and system function in their body.

Our results also showed a positive association between vitamin C and vitamin D. Studies have shown this relationship in which vitamin C and vitamin D deficiency together lead to decreased bone mineral density and increased risk of osteoporosis. They believed that deficiency in both vitamins may have a synergistic effect. Therefore, the study recommended routine measurement of vitamin C and vitamin D in clinical practice [51]. The results also revealed a positive association between vitamin C and vitamin E. This association between vitamins is clear, as vitamin C is the main supplement to vitamin E and works synergistically with vitamin E in protecting against oxidative damage [52]. A previous study in Basra Governorate indicated that lymphocytic leukemia patients are exposed to severe deficiency in vitamins A, E, and C [53], which means that neglecting vitamins in psoriasis patients is a not-so-distant danger.

Finally, we suggest that dermatologists treating psoriasis patients pay great attention to adding vitamins C, E, and D to the treatment prescription and to follow up on the evaluation of the levels of these variables, as a link was found between them. In other words, an aspect cannot be concerned with the other. Also, our findings suggest that the only concern for the appearance of the skin leaves the patient vulnerable to other diseases.

5. Conclusion

We can conclude that vitamins C, D, and E play an effective role in exposing psoriasis patients to other diseases, and that the concentration imbalance in these vitamins does not depend on the severity of the disease, the type of treatment, or the geographical location. This means these factors are imbalanced in the body. This study also finds that psoriasis patients need to intensify vitamin treatment because the deficiency is clear even for those under 20 years of age. This study also found that vitamin A, known as an antioxidant, is higher in rural patients than in urban patients. Additionally, vitamin D has been shown to rise more in females than males, while vitamin E increases more in males than females. Moreover, this study demonstrated that vitamin C is instrumental in

controlling the vitamins under study. A positive correlation has been noticed between vitamin C and D on the one hand and vitamin C and E on the other. Therefore, the importance of psoriasis patients' intake of vitamin C across age groups of the disease is highlighted.

Ethical Approval and Consent to Participate. The approval and consent to participate in this study has been granted by the Ethical and Research Committee of the Basrah Health Department, Training and Human Development Center.

Data Availability and Materials. The corresponding author has made the datasets used and analyzed in this study available upon reasonable request.

Conflict of Interest. The authors declare no conflicts of interest.

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Abbreviation

Vit A= Retinol
Vit C= Ascorbic Acid
Vit D= Calciferol
Vit E= Alphatocopherol

References

1. Capon, F. (2017). The genetic basis of psoriasis. *International Journal of Molecular Sciences*, *18*(12), 1–9. https://doi.org/10.3390/ijms18122526
2. Ran, D., Cai, M., & Zhang, X. (2019). Genetics of psoriasis: A basis for precision medicine. *Precision Clinical Medicine*, *2*(2), 120–130. https://doi.org/10.1093/pcmedi/pbz011
3. Damiani, G., Bragazzi, N. L., Karimkhani Aksut, C., Wu, D., Alicandro, G., McGonagle, D., … Naghavi, M. (2021). The global, regional, and national burden of psoriasis: Results and insights from the Global Burden of Disease Study. *Frontiers in Medicine*, *8*, 1–12. https://doi.org/10.3389/fmed.2021.743180
4. Griffiths, C. E. M., Armstrong, A. W., Gudjonsson, J. E., & Barker, J. N. W. N. (2021). Psoriasis. *The Lancet*, *397*(10281), 1301–1315. https://doi.org/10.1016/s0140-6736(20)32549-6
5. Potestio, L., Lauletta, G., Tommasino, N., Portarapillo, A., Salsano, A., Battista, T., … Megna, M. (2024). Risk factors for psoriasis flares: A narrative review.

Psoriasis (Auckland), *14*, 39–50. https://doi.org/10.2147/PTT.S323281
6. Osigwe, P. C., Agomoh, C. E., Osigwe, I. S., & Akumiah, F. K. (2024). The association between psoriasis and atherosclerotic cardiovascular disease: A systematic review and meta-analysis of observational studies. *Cureus*, *16*(6), 1–29. https://doi.org/10.7759/cureus.63379
7. Bellinato, F., Maurelli, M., Geat, D., Girolomoni, G., & Gisondi, P. (2024). Managing the patient with psoriasis and metabolic comorbidities. *American Journal of Clinical Dermatology*, *25*(4), 527–540.
8. Dattola, A., Silvestri, M., Bennardo, L., Passante, M., Scali, E., Patruno, C., & Nisticò, S. P. (2020). Role of vitamins in skin health: A systematic review. *Current Nutrition Reports*, *9*(3), 226–235. https://doi.org/10.1007/s13668-020-00322-4
9. Sahawneh, P. (2024). Factors influencing skin health from within. *Journal of Integrated Health*, *3*(1), 156–163. https://doi.org/10.51219/jih/pamela-sahawneh/26
10. Ragunatha, S., Kumar, V. J., & Murugesh, S. B. (2011). A clinical study of 125 patients with phrynoderma. *Indian Journal of Dermatology*, *56*(4), 389–389.
11. Wolbach, S. B. (1925). Tissue changes following deprivation of fat-soluble A vitamin. *Journal of Experimental Medicine*, *42*(6), 753–777. https://doi.org/10.1084/jem.42.6.753
12. Polcz, M. E., & Barbul, A. (2019). The role of vitamin A in wound healing. *Nutrition in Clinical Practice*, *34*(5), 695–700. https://doi.org/10.1002/ncp.10376
13. Jaros-Sajda, A., Budzisz, E., & Erkiert-Polguj, A. (2024). Ascorbic acid treatments as effective and safe anti-aging therapies for sensitive skin. *Antioxidants*, *13*(2), 1–10. https://doi.org/10.3390/antiox13020174
14. Hemilä, H., & A., M. E. (2024). Vitamin C deficiency can lead to pulmonary hypertension: A systematic review of case reports. *BMC Pulmonary Medicine*, *24*(1), 1–17.
15. Boo, Y. C. (2022). Ascorbic acid (vitamin C) as a cosmeceutical to increase dermal collagen for skin antiaging purposes: Emerging combination therapies. *Antioxidants*, *11*(9), 1–18. https://doi.org/10.3390/antiox11091663
16. Mastrangelo, D., Massai, L., Coco, G. F., & Coco, F. L. (2017). Vitamin C against cancer. *Vitamin C*, *1*, 63–90.
17. Gann, P. H. (2009). Randomized trials of antioxidant supplementation for cancer prevention. *JAMA*, *301*(1), 102. https://doi.org/10.1001/jama.2008.863
18. Brigelius-Flohé, R. (2021). Vitamin E research: Past, now and future. *Free Radical Biology and Medicine*, *177*, 381–390. https://doi.org/10.1016/j.freeradbiomed.2021.10.029

19. Saito, K., Yokoyama, T., Okaniwa, M., & Kamoshita, S. (1982). Neuropathology of chronic vitamin E deficiency in fatal familial intrahepatic cholestasis. *Acta Neuropathologica*, *58*(3), 187–192. https://doi.org/10.1007/BF00690800
20. Traber, M. G., & Stevens, J. F. (2011). Vitamins C and E: Beneficial effects from a mechanistic perspective. *Free Radical Biology and Medicine*, *51*(5), 1000–1013. https://doi.org/10.1016/j.freeradbiomed.2011.05.017
21. Mostafa, W. Z., & Hegazy, R. A. (2015). Vitamin D and the skin: Focus on a complex relationship: A review. *Journal of Advanced Research*, *6*(6), 793–804. https://doi.org/10.1016/j.jare.2014.01.011
22. AlGhamdi, S. A., Enaibsi, N. N., Alsufiani, H. M., Alshaibi, H. F., Khoja, S. O., & Carlberg, C. (2022). A single oral vitamin D_3 bolus reduces inflammatory markers in healthy Saudi males. *International Journal of Molecular Sciences*, *23*(19), 11992–11992. https://doi.org/10.3390/ijms231911992
23. Wiseman, H. (1993). Vitamin D is a membrane antioxidant. Ability to inhibit iron-dependent lipid peroxidation in liposomes compared to cholesterol, ergosterol and tamoxifen and relevance to anticancer action. *FEBS Letters*, *326*(1–3), 285–288. https://doi.org/10.1016/0014-5793(93)81809-E
24. shanghai Ideal Medical Technology Co., Ltd. (n.d.). Retrieved from www.shidealtech.com.
25. Campione, E., Cosio, T., Lanna, C., Mazzilli, S., Ventura, A., Dika, E., … Bianchi, L. (2020). Predictive role of vitamin A serum concentration in psoriatic patients treated with IL-17 inhibitors to prevent skin and systemic fungal infections. *Journal of Pharmacological Sciences*, *144*(1), 52–56. https://doi.org/10.1016/j.jphs.2020.06.003
26. Rollman, O., & Vahlquist, A. (1985). Psoriasis and vitamin A. *Archives of Dermatological Research*, *278*(1), 17–24. https://doi.org/10.1007/BF00412490
27. Rendon, A., & Schäkel, K. (2019). Psoriasis pathogenesis and treatment. *International Journal of Molecular Sciences*, *20*(6), 1–28. https://doi.org/10.3390/ijms20061475
28. Tampa, M., Nicolae, I., Ene, C. D., Sarbu, I., Matei, C., & Georgescu, S. R. (2017). Vitamin C and TBARS in psoriasis vulgaris related to PASI. *Revista de Chimie*, *68*(1), 43–47. https://doi.org/10.37358/RC.17.1.5385
29. Ghafel, B. N. Y. (2021). The relationship between the level of vitamin C and psoriasis. *Al-Kufa University Journal for Biology*, *13*(2), 8–21.
30. Al-Katib, S. R., Al-Wakeel, H. A., & Al-Rawaf, R. F. (2018). Role of vitamin C as antioxidant in psoriasis patients treated with NB-UVB phototherapy. *Indian Journal of Public Health Research & Development*, *9*(10), 408–413. https://doi.org/10.5958/0976-5506.2018.01372.4

31. Formisano, E., Proietti, E., Borgarelli, C., & Bertolini, S. (2023). Psoriasis and vitamin D: A systematic review and meta-analysis. *Nutrients*, *15*(15), 3387–3387. https://doi.org/10.3390/nu15153387
32. Aranow, C. (2011). Vitamin D and the immune system. *Journal of Investigative Medicine*, *59*(6), 881–886. https://doi.org/10.2310/JIM.0b013e31821b8755
33. Raymond-Lezman, J. R., & Riskin, S. I. (2023). Benefits and risks of sun exposure to maintain adequate vitamin D levels. *Cureus*, *15*(5), 1–11. https://doi.org/10.7759/cureus.38578
34. Lee, Y. H., & Song, G. G. (2018). Association between circulating 25-hydroxyvitamin D levels and psoriasis, and correlation with disease severity: A meta-analysis. *Clinical and Experimental Dermatology*, *43*(5), 529–535. https://doi.org/10.1111/ced.13381
35. Greb, J. E., Goldminz, A. M., Elder, J. T., Lebwohl, M. G., Gladman, D. D., Wu, J. J., Mehta, N. N., Finlay, A. Y., & Gottlieb, A. B. (2016). Psoriasis. *Nature Reviews Disease Primers*, *2*(1). https://doi.org/10.1038/nrdp.2016.53
36. Mattozzi, C., Paolino, G., Richetta, A. G., & Calvieri, S. (2016). Psoriasis, vitamin D and the importance of the cutaneous barrier's integrity: An update. *The Journal of Dermatology*, *43*(5), 507–514. https://doi.org/10.1111/1346-8138.13305
37. Hambly, R., & Kirby, B. (2017). The relevance of serum vitamin D in psoriasis: A review. *Archives of Dermatological Research*, *309*(7), 499–517. https://doi.org/10.1007/s00403-017-1751-2
38. Banavasi Shanmukha Girisha, N., Nayak, P., Noronha, T., & Handattu Sripathi. (2018). Low vitamin D in psoriasis: Reality or myth? *Indian Journal of Dermatology*, *63*(3), 255–255.
39. Barrea, L., Savanelli, M. C., Di Somma, C., Napolitano, M., Megna, M., Colao, A., & Savastano, S. (2017). Vitamin D and its role in psoriasis: An overview of the dermatologist and nutritionist. *Reviews in Endocrine and Metabolic Disorders*, *18*(2), 195–205. https://doi.org/10.1007/s11154-017-9411-6
40. Parikh, G., Varadinova, M., Suwandhi, P., Araki, T., Rosenwaks, Z., Poretsky, L., & Seto-Young, D. (2010). Vitamin D regulates steroidogenesis and insulin-like growth factor binding protein-1 (IGFBP-1) production in human ovarian cells. *Hormone and Metabolic Research*, *42*(10), 754–757. https://doi.org/10.1055/s-0030-1262837
41. Plantone, D., Pardini, M., Caneva, S., & De Stefano, N. (2024). Is there a role of vitamin D in Alzheimer's disease? *CNS & Neurological Disorders. Drug Targets*, *23*(5), 545–553. https://doi.org/10.2174/1871527322666230526164421
42. Liu, X., Yang, G., Luo, M., Lan, Q., Shi, X., Deng, H., Wang, N., Xu, X., & Zhang, C. (2021). Serum vitamin E levels and chronic inflammatory skin dis-

eases: A systematic review and meta-analysis. *PLoS ONE*, *16*(12), 1–17. https://doi.org/10.1371/journal.pone.0261259

43. Kanda, N., Hoashi, T., & Saeki, H. (2020). Nutrition and psoriasis. *International Journal of Molecular Sciences*, *21*(15), 1–18. https://doi.org/10.3390/ijms21155405
44. Guarneri, F., Bertino, L., Pioggia, G., Casciaro, M., & Gangemi, S. (2021). Therapies with antioxidant potential in psoriasis, vitiligo, and lichen planus. *Antioxidants*, *10*(7), 1–25. https://doi.org/10.3390/antiox10071087
45. Dauendorffer, J.-N., Ly, S., & Beylot-Barry, M. (2019). Psoriasis and male sexuality. *Annales de Dermatologie et de Vénéréologie*, *146*(4), 273–278. https://doi.org/10.1016/j.annder.2019.01.021
46. Azzi, A., & Stocker, A. (2000). Vitamin E: Non-antioxidant roles. *Progress in Lipid Research*, *39*(3), 231–255. https://doi.org/10.1016/S0163-7827(00)00006-0
47. Rahmah, S., Alibraheem, S., & Mahmoud, R. (2022). Risk factors' estimation of non communicable diseases in Al-Basrah Province/Iraq during 2020–2021. *Indian Journal of Forensic Medicine & Toxicology*, *16*(1), 1405–1413.
48. Qurbonova, S., Rajabboyeva, S., & Toshtemirov, A. (2024). Fat-soluble vitamins. *Science and Innovation in the Education System*, *3*(3), 201–204.
49. Turck, D., Bohn, T., Castenmiller, J., de Henauw, S., Hirsch-Ernst, K.-I., Knutsen, H. K., Maciuk, A., Mangelsdorf, I., McArdle, H. J., Pentieva, K., Siani, A., Thies, F., Tsabouri, S., Vinceti, M., Lietz, G., Passeri, G., Craciun, I., Fabiani, L., Horvath, Z., & Martinez, S. V. (2024). Scientific opinion on the tolerable upper intake level for preformed vitamin A and β-carotene. *EFSA Journal*, *22*(6), 1–119.
50. Bakic, M., Klisic, A., Kocic, G., Kocic, H., & Karanikolic, V. (2024). Oxidative stress and metabolic biomarkers in patients with psoriasis. *Journal of Medical Biochemistry*, *43*(1), 97–105. https://doi.org/10.5937/jomb0-45076
51. He, L., Chhantyal, K., Chen, Z., Zhu, R., & Zhang, L. (2024). The association of combined vitamin C and D deficiency with bone mineral density and vertebral fracture. *Journal of Orthopaedic Surgery and Research*, *19*(1), 1–8. https://doi.org/10.1186/s13018-024-04953-z
52. Niu, F., Xie, W., Zhang, W., Kawuki, J., & Yu, X. (2023). Vitamin C, vitamin E, β-carotene and risk of Parkinson's disease: A systematic review and dose-response meta-analysis of observational studies. *Nutritional Neuroscience*, *27*(4), 1–13.
53. Al-Maliki, A. A. H., & Abbas, A.-M. (2022). Estimation of oxidative stress enzymes and vitamins levels in acute lymphocytic leukemia patients in the governorate of Basrah, Iraq. *Tropical Journal of Natural Product Research*, *6*(4), 542–545.

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