

The Roles of Vitamin C Supplementation in Skin Diseases

A Randomized Clinical Trial

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ABSTRACT

A prospective randomized single blind clinical trial conducted at AL-Hilla Teaching Hospital and Al Sadeq hospital in Al-Hilla, Babylon, Republic of Iraq during a period of 10 months started by enrollment of the first patient at 15th June 2018 to the last follow up date at 20th April ... Including 20 psoriasis and 20 acne vulgaris patients of both genders. All patients were clinically assessed and their vitamin C levels were investigated before giving the vitamin C supplementation, then, they supplemented in addition to their traditional treatment with 500 mg/day vitamin C, in two divided doses and followed up for 6 weeks. Their response assessed by the severity and grading indices of psoriasis and acne at three and 6 weeks after supplementation. Findings revealed a significant reduction in the psoriasis area and severity index of psoriasis group and the global acne grading system scores of acne group which indicated a beneficial effect of adding vitamin C 500 mg/day as a safe tolerable medication in those patients.

Keywords: Skin disease, vitamin C, psoriasis, Acne vulgaris, epidemiology, treatment

1.INTRODUCTION

The skin is a multi-functional organ, the largest in the body, and its appearance generally reflects the health and efficacy of its underlying structures. It has many functions, but its fundamental role is to provide a protective interface between the external environment and an individual's tissues, providing shielding from mechanical and chemical threats, pathogens, ultraviolet radiation and even dehydration (1). Being in constant contact with the external environment, the skin is subject to more insults than most of our other organs, and is where the first visible signs of aging occur. The skin is composed of two main layers with quite different underlying structures; the outermost epidermis and the deeper dermis (1,2).

Normal skin contains high concentrations of vitamin C, which supports important and well-known functions, stimulating collagen synthesis and assisting in antioxidant protection against UV-induced photodamage. This knowledge is often used as a rationale for the addition of vitamin C to topical applications, but the efficacy of such treatment, as opposed to optimizing dietary vitamin C intake, is poorly understood. However, no strong evidence about the potential benefits of vitamin C in skin diseases or which skin properties are more likely to get benefit of improvement of vitamin C intake. Moreover, scientific literatures and previous studies reported a controversial results about the function and effect of vitamin C in skin diseases and such role of vitamin C is still under debate (2,3).

Function of vitamin C in different body systems:

For decades the scientific community has been emphasizing the relationship between proper nutrition, nutritional status and the functioning of the body systems (4)(5). Thus, some nutrients have been postulated as modulators of human cellular components and immune system , therefore , these nutrients have a significant roles in maintaining body functions in different ways, some act as antioxidants , anti-inflammatory and play important role in prevention of many diseases. Vitamins, such as vitamin C and minerals, such as zinc (6,7) proved to have significant effect in this aspect. Vitamin C, also known as ascorbic acid and L-ascorbic acid, is a vitamin that is found in food and is used as a food supplement . As an adjunct, it is used for the treatment and prevention of scurvy. Vitamin C is an important nutrient involved in tissue repair wound healing and protect against UV light (8–11) . Vitamin C is a micronutrient that has traditionally been recognized as a power against acute infections, common cold, etc. (12,13), and whose effectiveness on the immune system has been studied(14). The use of vitamin C supplements every day is a fairly widespread practice, additionally, scientific community postulated that

vitamin C stimulates the immune system and act in synergism with β -glucans in similar responses. However, it is thought to improve immune function, but the mechanisms involved are still obscure (15,16). Furthermore, L-ascorbic acid or vitamin C is an electron donor that contributes to the prevention of oxidative damage. This mechanism is beneficial in many human diseases. As an antioxidant, it protects the body from various harmful effects such as free radicals, pollutants and toxins. In addition, L-ascorbic acid is essential for the biosynthesis of collagen and L-carnitine (17–19). It had been postulated that the body needs vitamin C for normal physiological functions; It helps in the synthesis and metabolism of tyrosine, folic acid and tryptophan, the hydroxylation of glycine, proline, lysine, carnitine and catecholamines (7). It also increases the absorption of iron in the intestine by reducing the ferric to the ferrous state (20,21).¹⁵. Vitamin C Can regenerate other antioxidants such as vitamin E, act as cofactor of reactions that require reduced copper or iron metalloenzyme and it is known as an electron donor for eight human enzymes involved in the hydroxylation of collagen and the biosynthesis of hormones and amino acids. From other point of view, vitamin C documented to Stimulates the functions of leukocytes (neutrophils, and monocytes), improves the integrity of the epithelial barrier, maintains the oxidative state of cells and protects against reactive oxygen species generated during inflammatory response through its antiviral and antioxidant properties. Given the antioxidant power of vitamin C, has many roles in cellular metabolism, aids in oxidation reduction reactions and acts as an enzyme cofactor, and can be used as adjunct in the treatment of psoriasis, where some studies indicated that increasing intake of vitamin C may aid in preventing the imbalance between oxidative stress and antioxidant defense (22,23).

Vitamin C deficiency leads to decrease in interferon, T lymphocyte activity and collagen production, and reduction of resistance to diseases. Supplementation with high doses of vitamin C stimulates phagocytic activity and T lymphocyte activity (12,14).

Structure and chemistry of vitamin C

Vitamin C is an organic compound dissolves well in water to give mildly acidic solutions. It consists of 6 carbon atoms, 8 hydrogen atoms and 6 oxygen atoms, it is a carbon based structure with a formula of (C₆H₈O₆) and a molecular weight of (176.1256). The name "vitamin C" always refers to the L-enantiomer of ascorbic acid and its oxidized forms. Ascorbic acid is a weak sugar acid structurally related to glucose. In biological systems, ascorbic acid can be found only at low pH, but in neutral solutions above pH 5 is predominantly found in the ionized form, ascorbate. Numerous analytical methods have been developed for ascorbic acid detection. Plasma

vitamin C concentration is tightly controlled by three primary mechanisms: intestinal absorption, tissue transport, and renal reabsorption (24–28).

The Recommended Dietary Allowance (RDA)

In the US, the recommended dietary allowance (RDA) for vitamin C was revised in 2000 upward from the previous recommendation of 60 mg daily for men and women (*Table below*). The RDA is based on the amount of vitamin C intake necessary to maintain neutrophil concentration with minimal urinary excretion of ascorbic acid, presumed to provide sufficient antioxidant protection (Bendich, 2001). The recommended intake for smokers is 35 mg/day higher than for nonsmokers, because smokers are under increased oxidative stress from the toxins in cigarette smoke and generally have lower blood levels of vitamin C (29,30).

Recommended Dietary Allowance (RDA) for Vitamin C (31)

Life Stage	Age	Males (mg/day)	Females (mg/day)
Infants	0-6 months	40	40
Infants	7-12 months	50	50
Children	1-3 years	15	15
Children	4-8 years	25	25
Children	9-13 years	45	45
Adolescents	14-18 years	75	65
Adults	19 years and older	90	75
Smokers	19 years and older	125	110
Pregnancy	18 years and younger	-	80
Pregnancy	19 years and older	-	85
Breast-feeding	18 years and younger	-	115
Breast-feeding	19 years and older	-	120

Vitamin C and Skin Disease:

Vitamin C as a major extra and intracellular water soluble antioxidant, it appears to be a significant factor in the skin. It plays an important role in maintaining skin health and can promote the differentiation of keratinocytes and decrease melanin synthesis. From other point of view, clinical trials revealed that vitamin C supplementation has a promising ameliorating effect in skin disease and it is able to prohibit the peroxidation of lipids (10,18,32). Moreover, previous studies referred that phototherapy for some skin diseases such as psoriasis increases the oxidative

stress in those patients and recommended vitamin C supplementation to patients with psoriasis treated by narrow band Ultraviolet B Phototherapy as a promising safe antioxidant protect against UV-induced photodamage with a good ameliorating effect on oxidative stress (2,18,22,33).

A strong evidence that normal skin needs high concentrations of vitamin C which is utilized for the formation of the skin barrier and collagen in the dermis, counteract skin oxidation, and the modulation of cell signal pathways of cell growth and differentiation. Previous cohort studies proved that vitamin C deficiency could be a risk factor for the development or aggravating skin diseases such as atopic dermatitis, acne vulgaris, psoriasis and porphyria cutanea tarda (PCT). From other point of view, vitamin C supplementation with high doses had been documente to have singnificant role in reduction of viability of cancer and stimulates apoptosis in malignant melanomas. Also previous studies reported that the combination of vitamin C and vitamin E inhibits melanocyte production (10,11). The effects of food restriction on changes in nutrient intake and severity of the skin disease have been investigated; with ascorbate as a prodrug in various skin diseases, clinical treatment strategies for how to correctly apply vitamin C have become of interest to many dermatologists (10,11). However, few clinical trials were performed to assess the role of vitamin C supplementation as a therapeutic adjuvant in other skin diseases and other associated factors, hence in this study we tried to assess the advantage of adding vitamin C supplementation to traditional treatment of some skin disease to estimate the benefit of this supplementation among group of Iraqi patients with skin diseases, including 3 skin diseases ; psoriasis, Acne and dermatitis (2).

2. PATIENTS and METHODS

This was a prospective randomized single blind clinical trial conducted at AL-Hilla Teaching Hospital and Al Sadeq hospital in Al-Hilla, Babylon, Republic of Iraq during a period of 10 months started by enrollment of the first patient at 15th June 2018 to the last follow up date at 20th April ...

Patients:

A total of 40 patients with skin diseases; two disease were included, psoriasis and acne vulgaris, other skin disease were excluded to get more precise conclusions and to prevent dissociation and dispersion of the data. Patients were equally selected according to their disease; 20 patients with proved diagnosed psoriasis of different severity according to the psoriasis area and severity index (PASI) represented psoriasis group, and 20 patients who had different grades of acne vulgaris , namely acne group. To control any possible effect of gender on response to

treatment, equal proportion of both genders were selected in both groups of patients; 10 males and 10 females in each of psoriasis and acne groups

Inclusion criteria:

Patients were included in the study according to the following criteria:

1. Adult patients aged 18 years or older
2. Of both genders
3. Have proved diagnosed skin diseases; Psoriasis or acne vulgaris
4. Agreed to participate and signed an informed consent

Exclusion criteria

Patient who had one or more of the following criteria was excluded:

Patient was excluded from the study if he/she had one or more of the

1. Currently use vitamin C supplementation for other conditions
2. Have one or more of chronic diseases.
3. Smoker.
4. Pregnant women
5. Obese patient; body mass index above 30 kg/m²
6. Patient with infectious or other skin diseases rather than psoriasis and acne.
7. Patient with Iron deficiency anemia
8. Patients who missed to follow up was also excluded

Methods:

Treatment protocol:

The traditional treatment of the patients in both acne and psoriasis groups of the study was continued. Vitamin C 480 mg daily was added as supplementation in form of in effervescent tablet in two divided doses (each effervescent tab contained 240 mg vitamin C) and given as one x 2 for 6 weeks. The vitamin C tablets package label was hided to assure the patient's blindness regarding the medication ,however, the patient informed that they will receive a type of tonics without mentioning the name of vitamin C to increase the patient's trust and ascertain that the patient will continue the medication and also to control any possible confounding effect or bias that may result from extra intake of vitamin C when the patient increases his/her dietary intake of vitamin C.

Clinical assessment:

Before we start vitamin C supplement , all patients were assessed clinically and their disease status was reported such as severity, involved area and the medication used. All patients informed to continue their prescribed medications by the dermatologists.

Assessment of diseases severity

The severity of diseases was assessed before and after treatment in both groups according to the standard guidelines;

For psoriasis, we used the psoriasis area and severity index (PASI) which combines assessment of four body areas; head and neck area, trunk, and lower limbs, according to the percentage of the affected area a numerical score was given , a score of 1 given when the affected area was 0 – 9%, a score of 2 for an area of 10 – 29%, 3 score for 30-49% , 4 given for the affected area of 50 – 69%, 5 score for a percentage of 70 – 89% and a score of 6 was given for the affected area of 90-100%. On the other hand, at each area the severity of signs of laque including the erythema, thicknesses/idurations, desquamation /scaling, were assessed on a scale of five points (0 – 4), as none, mild, moderate, severe or very severe that given a score of 0, 1 , 2 , 3 or 4 , respectively. The total score ranged 0 – 72 and calculated as the summation of these scores , accordingly, a total PASI score of < 10 indicated mild disease, 10-20 moderate and > 20 is severe disease form (34).

For Acne, despite the presence of different classification and grading systems for severity of acne we preferred the Global Acne Grading system (GAGS) (35,36), because it is more reliable and produce a scale variable which is statistically better for comparison, the severity according to this system was assessed by giving a score value for each lesion according to severity; zero value indicated no lesion, score of 1 for comedone, 2 for papule, 3 for pustule, and 4 for nodules. The total score then calculated and categorized as follow:

Total score of (1 – 18) = mild

Total score of (19 - 30) = moderate

Total score of (31 - 38) = severe

Total score of (≥ 39) = very severe

Data collection:

Data of the patients were collected using a pre-constructed data collection sheet for each patient in both arms of the study by full history taking and thorough clinical examination.

Baseline characteristics were reported including the age, gender, type of skin disease, duration of the skin disease, medical history, treatment history and laboratory findings including routine blood studies and serum level of vitamin C before treatment. After initiation of vitamin C supplement and continue traditional treatment, a scheduled follow up visits were arranged with two weeks interval at each visit, patients were clinically assessed and their response to treatment were reported, additionally, the serum level of vitamin C was assessed in both study groups at three points of time; baseline (before treatment), three weeks after treatment and at the end of the sixth week of follow up. Skin diseases severity and response was also assessed.

Laboratory investigations:

A sample of venous blood was taken from each participant before and after treatment under aseptic condition and send for laboratory testing. All laboratory investigations were performed in private laboratory managed by specialist laboratory professional physicians and all these tests were funded by the researchers. Vitamin C kits provided by the researchers and tested in the lab using ELISA technique. Vitamin C testing performed by competitive inhibition enzyme immunoassay technique with a detection range of 192.1 - 40,000 ng/ml

Collection of blood samples:

A 5 ml sample of peripheral venous blood was drawn from each participant patient before and after treatment at the end of follow up period. All blood samples were collected after overnight fasting of the patients for at least 12 hours.

Statistical analysis:

Data of the patients were entered, managed and analyzed using the statistical package for social sciences (SPSS) version 25 (SPSS). Descriptive statistics presented as mean standard deviation and range for continuous variables and as frequencies and proportions for categorical variables. Continuous variables were examined for normal statistical distribution using Kolmogorov-Smirnov test, all appeared to follow this distribution. Paired t test used to compare means before and 6 weeks after supplementation of vitamin C (500 mg/day) in each group at the subsequent visits. Chi square test used to assess the significance of changes in severity categories of acne and psoriasis groups before and 6 weeks after vitamin C supplementation. Bivariate correlation analysis (Pearson's and Spearman's) tests used to assess the correlation between demographic variables and disease duration from one side against the severity scores of psoriasis and acne from the other side, the correlation coefficient (R) value was calculated which an estimator for the strength of correlation, the R value statistically ranged between 0 and 1, the value closer to one indicated the stronger correlation, the negative signed R indicated an inverse (negative)

correlation. Level of significance, P. value ≤ 0.05 was considered as significant difference.

3. RESULTS

A total of 40 patients with skin diseases, 20 cases with acne vulgaris and 20 cases with psoriasis, were enrolled in this clinical trials, their baseline characteristics are shown in (Table 1), the mean age of psoriasis patients was 43.8 ± 12.3 (Range: 26 – 61) years and for those in acne group it was 26.7 ± 3.6 (Range: 19 – 32) years, it seemed that acne patients were younger than psoriasis group, (Figure 1). The distribution of diseases duration varied between both studied groups, psoriasis patients had longer disease duration than acne group, mean duration was 12.9 vs. 5.2 years, respectively, it ranged 3 – 30 years in psoriasis group and 2 – 7 years in acne group, (Table 2).

The serum vitamin C level was significantly increased in both of psoriasis and acne groups. In psoriasis group the mean S. vitamin C was 2121.3 pg/dl increased after 3 weeks of supplementation to 2728.5 pg/dl to reach 3218.7 at the sixth weeks after supplementation. The mean difference was 1097.4 with a percentage change of 51.7%, with highly significant P. value of < 0.001 . In Acne group , similar trend was reported, (P. value < 0.001), (Table 3).

The changes in acne severity score of acne group was significant at P. value < 0.001 , the mean GAGS before supplementation of 500 mg/day vitamin C was 24.4 reduced at the third week to 18.7 and more reduced at the 6th week after supplementation, with a mean difference of -11.1 (negative sign indicates a reduction) to reach a mean of 13.3, (Table 4).

From other point of view, before supplementation of vitamin C in acne group , only 2 patients had mild disease, 15 with moderate and 3 with severe disease according to GAGS, after vitamin C supplementation at the end of the 6th week of follow up, a significant change was reported, where 13 patients (65%) had mild disease, 6 patients with moderate and only one patient remain with severe form of acne, the change was statistically significant, (P= 0.022), (Table 5).

Similarly in psoriasis group, the mean baseline PASI score was 21.2 reduced to 15.2 at the third week and reached 9.1 at the sixth week with a mean difference of – 12.1 and a percentage change of 57.0%, (P. value < 0.001), (Table 7).

Additionally, before supplementation, 4 cases had mild psoriasis according to PASI score, 9 moderate and 7 had severe form of psoriasis, after 6 weeks of supplementation with 500 mg/day of vitamin C , 12 patients had mild, 6 moderate and only 2 with severe diseases, and the change was significant , (P. value = 0.025, significant) , (Table 7).

Moreover, curve estimation (regression analysis) revealed that serum level of vitamin C was inversely associated with severity score in both studied groups. R value in acne group was -0.721, (P. value = 0.001) and in psoriasis group was -0.632, (P. value = 0.004), (Figures 2 & 3).

Further analysis was performed to assess the significance of correlation between baseline demographic characteristics of patients in acne and psoriasis group , however, no significant correlation was reported , (P. value > 0.05) in both groups, (Table 8)

Table 1. Baseline characteristics of the studied group

Variable		No.	%
Gender	Male	20	50.0
	Female	20	50.0
Age (year)	≤ 30	17	42.5
	31 - 40	10	25.0
	> 40	13	32.5
Family history	Yes	13	32.5
	No	27	67.5
Marital status	Single	11	27.5
	Married	26	65.0
	Divorced/widowed	3	7.5
Occupation	Employed	11	27.5
	Unemployed	17	42.5
	Student	8	20.0
	Retired	4	10.0

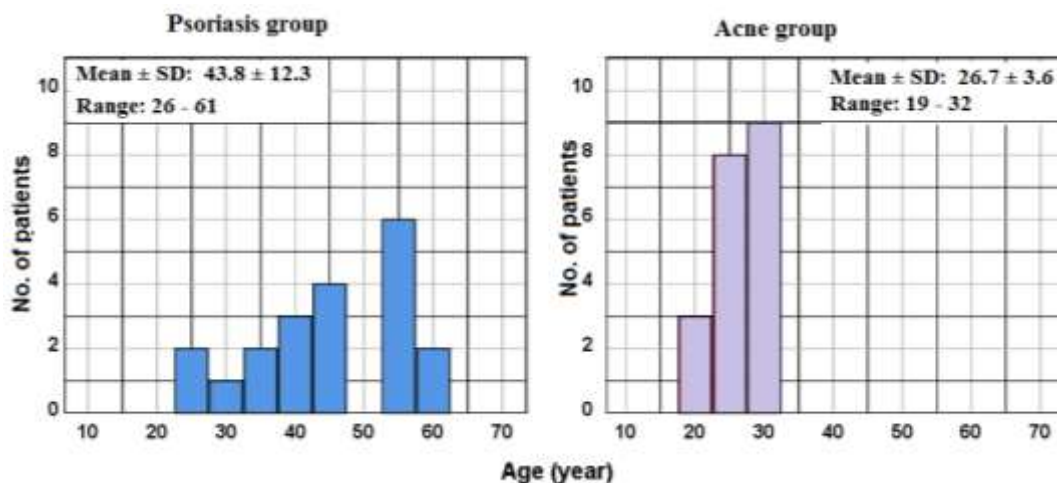


Figure 1. Age distribution of psoriasis and Acne vulgaris patients

Table 2. Distribution of duration of skin diseases of the studied groups

Duration (year)	Psoriasis group	Acne group
Mean	12.9	5.2
Standard Deviation	7.3	3.1
Minimum	3.0	2.0
Maximum	30.0	7.0

Table 3. Changes in serum vitamin C levels during the follow up period in psoriasis and acne groups after vitamin C supplementation of 500 mg/ day

Assessment point	Serum Vitamin C level (pg/dL)			
	Psoriasis group (n = 20)		Acne group (n = 20)	
	Mean	SD	Mean	SD
Before supplementation	2121.3	467.4	2137.7	421.9
Three weeks after supplementation	2728.5	436.4	2519.8	421.6
Six weeks after supplementation	3218.7	696.3	3223.6	652.1
Mean difference*	1097.4	227.2	1085.9	336.8
Percentage change	51.7%	7.0%	50.8%	9.0%
<i>P. value within group (paired t test)</i>	< 0.001		< 0.001	

Table 4. Changes in acne severity score (GAGS) of acne patients during the follow up period in psoriasis and acne groups after vitamin C supplementation of 500 mg/ day

Assessment point	GAGS	
	Mean	SD
Before supplementation	24.4	7.2
Three weeks after supplementation	18.7	6.9
Six weeks after supplementation	13.3	7.5
Mean difference*	-11.1	1.2
Percentage change	-45.4%	5.0%
<i>P. value within group (paired t test)</i>	< 0.001	

Table 5. Comparison of acne severity before and after supplementation of vitamin C , 500 mg/day, among acne group (n = 20)

Acne Severity	Before supplementation		After supplementation	
	No.	%	No.	%
Mild	2	10.00%	13	65.00%
Moderate	15	75.00%	6	30.00%
Severe	3	15.00%	1	5.00%
Total	20	100.0	20	100.0
Chi square was significant at P. value = 0.022				

Table 6. Changes in psoriasis severity score (PASI) of psoriasis patients during the follow up period in psoriasis and acne groups after vitamin C supplementation of 500 mg/ day

PASI	PASI	
	Mean	SD
Before supplementation	21.2	6.2
Three weeks after supplementation	15.2	4.1
Six weeks after supplementation	9.1	1.1
Mean difference*	-12.1	1.8
Percentage change	-57.0%	8.6%
P. value within group (paired t test)	< 0.001	

Table 7. Comparison of psoriasis severity before and after supplementation of vitamin C , 500 mg/day, among acne group (n = 20)

Psoriasis severity	Before supplementation		After supplementation	
	No.	%	No.	%
Mild	4	20.0	12	60.0
Moderate	9	45.0	6	30.0
Severe	7	35.0	2	10.0
Total	20	100.0	20	100.0

Chi square was significant at P. value = 0.025

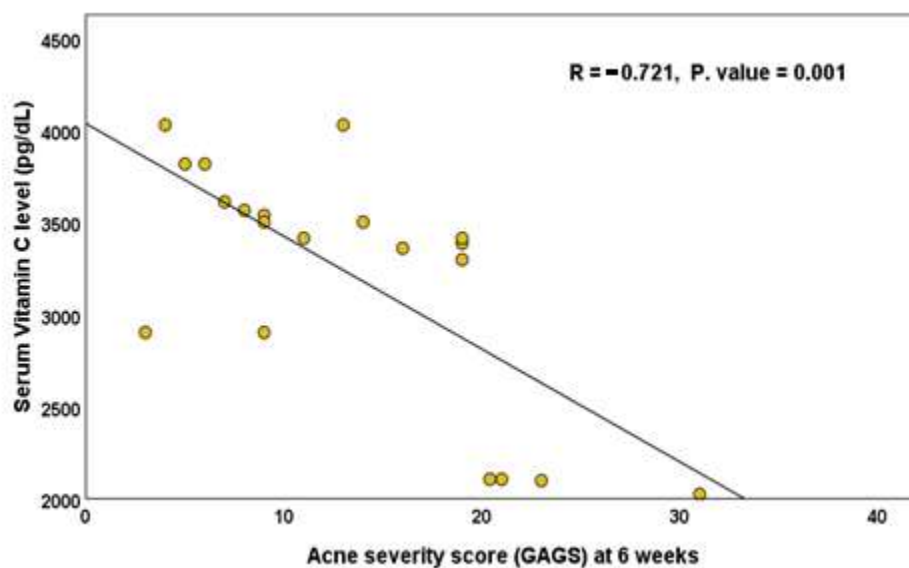


Figure 2. Curve estimation (regression) showing the inverse correlation between serum level of vitamin C at 6th week after supplementation and acne severity score of acne group (n=20)

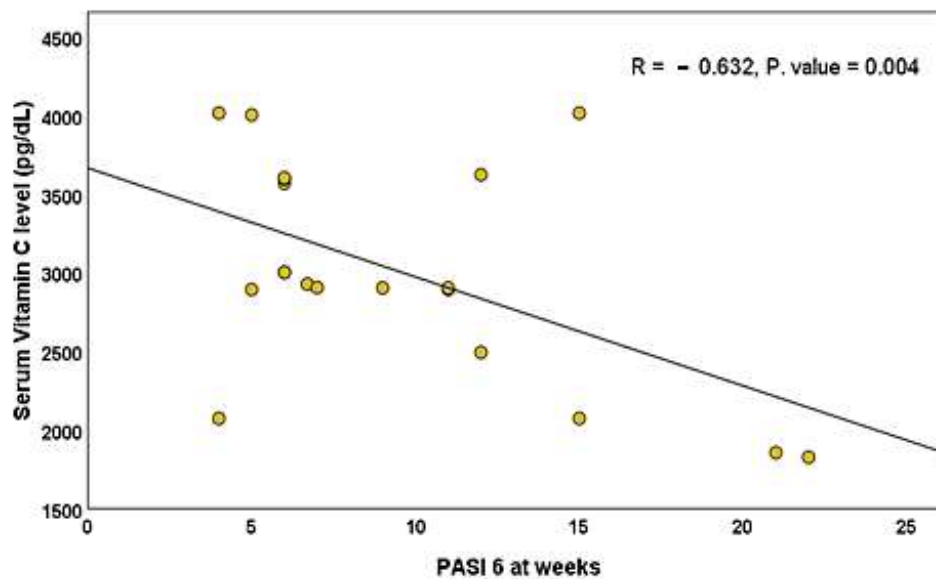


Figure 3. Curve estimation (regression) showing the inverse correlation between serum level of vitamin C at 6th week after supplementation and PASI score of psoriasis group (n=20)

Table 8. Results of bivariate correlation analysis for changes in acne and psoriasis severity scores against the demographic characteristics and disease duration of the studied groups

Variable in equation	Correlations versus			
	GAGS change		PASI change	
	R	P. value	R	P. value
Gender	-0.227	0.336	-0.007	0.976
Age	-0.007	0.976	0.187	0.429
Family history	0.126	0.431	0.112	0.638
BMI	0.013	0.957	-0.325	0.163
Marital status	0.007	0.977	0.074	0.692
Occupation	0.067	0.778	-0.071	0.767
Disease duration	-0.089	0.710	0.130	0.338

4. DISCUSSION

The skin diseases are significant health problem affecting the whole health status of individuals and have much concerns among both, peoples and dermatologists. Psoriasis is a common inflammatory skin disease with unknown etiology and its treatment have much concern of dermatologist, on the other hand, acne vulgaris affecting many individual worldwide and have adversely affect the quality of life of affected subjects, therefore, different modalities of treatment are available now a days for these two diseases, however, scientific dermatologist community still searching for new treatment modalities or adding substances that will be beneficial to those patients (37–39). It is widely accepted that that nutritional status with respect to both macronutrients and micronutrients is important for skin health and appearance (11), vitamin C proved to have an important role in maintaining skin health, and its deficiency can lead to or worsening some skin diseases (2). Vitamin C involved in the maintainance of dermis and plays physiological role in the protection of skin against oxidation, cell signal pathway, cell growth and development, also it acts in dual roles as antioxidant and pro-oxidant (23), this dual role contributes to the balance of these reactions, according to these roles and effect of vitamin C, it involved in protection of many skin diseases that related to these mechanisms, previous studies, assess the role of vitamin C as adjuvant therapy in different skin diseases , however, few clinical

trials are available that examine the effect of adding vitamin C to traditional treatment in psoriasis and acne patients, to best of our knowledge, this the first study in Iraq, the only available Iraqi study concerned with the effect of vitamin C as antioxidant in psoriasis patients treated with narrow-band UVB phototherapy, while other studies assessed the roles of other nutrients and vitamins (22).

Hence, in the present study we tried to assess the effect of adding vitamin C supplementation to traditional treatment of group of Iraqi patients with skin diseases; psoriasis and acne vulgaris. The selection of these two diseases due to their importance and concern among affected individual and the dermatologist commonly seen those patients. We included 40 patients 20 for each disease, males and females were equally distributed to control the effect of gender on the results. Patients were blinded for the vitamin C supplementation, and followed up for 6 weeks after initiation of supplementation. Psoriasis patients were older than acne group, and this was expected according to the epidemiological patterns of these two diseases where acne is a common skin disorder of teenagers and psoriasis affects while psoriasis had a peak incidence in 15 – 20 years old and another peak at 55-60 years giving a bimodal distribution (36,40)

The present study found that the level of vitamin C was significantly increased more than half its baseline level, at the subsequent assessment at three and six weeks than its baseline levels before supplementation in both psoriasis and acne groups, this was absolutely expected as we give 500 mg/day vitamin C and the serum level certainly will increased. These findings agreed that reported in previous studies that measure the serum vitamin C after supplementation (22,29,30). Interestingly, previous studies reported that the levels of vitamin C in psoriasis and acne vulgaris patients are lower than normal individuals and that vitamin C uptake is more rapid in these patients (1,3,10,22).

In the current study we found a significant reduction in the mean Global Acne Grading score (GAGS) than its baseline levels before vitamin C supplementation in acne group and also a significant reduction in the psoriasis area and severity index in psoriasis group, and there were inverse significant correlation between the serum vitamin C levels at the 6 weeks and each of GAGS and PASI, (R. value = - 0.721, p. value = 0.001) and (R. value = - 0.632, p. value = 0.004), respectively. These findings consistent with that reported in previous studies; Iinuma et al., 2011 documented that the combination of zinc and clarithromycin, along with vitamin C, has an antibacterial effect against clarithromycin-resistant *P. acnes* in vitro and this combination lead to enhance susceptibility of *Propionibacterium acnes* and improvement of patients to lower acne

grade providing a new idea for the clinical use of antibiotics in the treatment of acne bacteria (41). Chawla in 2014 documented significant role of vitamin C in treatment of atrophic post acne scars and that vitamin C play important role in the improvement of skin hardness, smoothness and post-inflammatory pigmentations (42). In psoriasis, vitamin C play an important role by returning keratinocytes return to normal status; Soodgupta et al., 2014 documented that ascorbic acid and statin act by modulating the LXR-a and the effector genes (43). From other point of view, vitamin C as antioxidant, lead to significant reduction in the oxidative stress in psoriatic patients on phototherapy due to its effect in reducing the oxidative stress; Al-Katib et al. documented that vitamin C supplementation in psoriasis patients receiving phototherapy reduced the malondialdehyde and glutathione oxidative stress marker (22) Waly et al. reported that low nourishment of vitamin c induces glutathione depletion and oxidative stress in healthy young adults (3). However, we disagreed with the findings of Al-Katib et al. (22) study regarding the PASI score where they did not found a significant reduction in PASI score in their study in patients supplemented with vitamin C, this disagreement could attributed to the difference in the sample size, and the effect of phototherapy , where they included patients on NB-UVB while we did not and the effect of vitamin C might masked by the effect of phototherapy. From other point of view, previous studies assessed the role of vitamin C in other skin diseases and can also reduce allergies often encountered in dermatology(2,7,10,12,33,44), however, this is out of the scope of our study Fortunately, no side effect was reported for vitamin C supplementation so that , we did not obligated to discontinue the supplementation.

Our study is not free of limitation; one of these is the small sample size , this attributed to the nature of clinical trials designs we couldn't include more patients as we have to investigate the patients for three times baseline and two times post supplementation and the follow up needs long duration. However, further studies with larger sample size and longer duration can overcome this limitation.

5. CONCLUSIONS

Adding Vitamin C supplementation of 500 mg/day for six weeks showed a significant improvement in the response to treatment and severity of psoriasis and Acne patients.

Vitamin C was safe tolerable substance and can be added as adjuvant in treatment of psoriasis and acne

Ethical Clearance: All ethical issues were approved by the authors from the local ethical committee. Informed signed consents were obtained from all participants prior to enrollment in the study treatment protocol. All data were collected in accordance with World Medical Association assembly declaration of Helsinki 2013 for the researches including humans

Conflict of interest: No conflict of interest declared by the authors

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