**Effect of CoQ10 Administration to Psoriatic Iraqi Patients on Biological Therapy Upon Severity Index (PASI) and Quality of Life Index (DLQI) Before and After Therapy.**

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**ABSTRACT**

Psoriasis is a medical condition in which the skin of the body is affected in a multisytemic level. Patients with moderate to severe psoriasis have a considerably reduced quality of life as a result of their disease. For morphological indicators, The Psoriasis Area Severity Index (PASI) test is one of the methods that have been tested for indicating the severity of the illness.An imbalance between pro-oxidants and antioxidants in our bodies causes oxidative stress to play a crucial role in the pathophysiology of chronic inflammatory diseases like psoriasis(1).It has been considered that antioxidant treatment can turn out to be an effective therapeutic option. The goal of this clinical investigation was to see if there was a link between the percentage change in quality of life and the clinical severity of psoriasis during a 12-week period among Iraqi psoriatic patients. Over the course of three months, 24 psoriatic patients (9 females and 15 males) ranging in age from 17 to 72 years old participated in a prospective double-blind clinical experiment. Two groups of participants were formed. A biological medicine (Adalimumab) and a placebo was given to group A (n=11), while group B (n=13) received 100 mg CoQ10 adjuvant therapy in addition to the biological medication already provided. The Psoriasis Area and Severity Index (PASI) and the Dermatology Life Quality Index (DLQI) were used to examine patients (DLQI). From treatment, with both biological and adjuvant CoQ10 therapy, showed a substantial association between the PASI and the DLQI (p value = 0.000132). After three months of therapy, the mean SD of PASI score for all patients was 20.88 $\pm $7.15, with a 67.48 $\pm $22.25032 percent improvement change. The mean SD of the DLQI score at baseline was 12.5 $\pm $4.71, with a change of 56.13 $\pm $20.15 percent following treatment. After therapy with a biological medication, there was a favorable association between the PASI and the DLQI (p>0.05). This indicates that therapy with a biological medication with daily administration of 100 mg CoQ10 supplements to psoriatic patients for 12 weeks improved the correlation between the PASI and DLQI.

**Keyword:** PASI, DLQI, CoQ10, Psoriasis,Biological Therapy.

**Introduction**

Psoriasis (Ps) is a multisystemic chronic inflammatory disease caused by a genetic factor that affects 2% to 3% of the global population (2). Psoriasis vulgaris accounts for approximately 85 to 90% of all psoriasis patients (3) (4).

The pathophysiology of psoriasis is complicated, and many processes involved are yet to be identified. The inflammatory response is influenced by a complicated interplay between genetic susceptibility and environmental factors (1). The condition has the potential to drastically damage the assaulted patient's physical and psychological function, as well as have a direct negative impact on their quality of life (5) (6). Several techniques have been used to assess the severity of psoriasis and its influence on quality of life.

The Psoriasis Area and Severity Index (PASI) is a clinical tool for assessing psoriasis severity, it combines severity parameters (erythema, induration, and desquamation, as well as the percentage of affected area) (7) (8).

The issue with the Dermatology Life Quality Index (DLQI) is that it is used to assess quality of a good life in six sections. These are also influenced by skin disease namely, symptoms and sentiments, daily activities, leisure, job, personal relationships, and treatment discomfort (9). Both PASI and DLQI are among the most quoted and frequently used psoriasis evaluation methods because of their high level of reliability, applicability, and reproducibility.

Psoriatic patients with a PASI or DLQI score of less than 10 are said to have mild psoriasis, while those with scores of more than 10 are said to have moderate to severe psoriasis (10). Psoriasis is a chronic, hyperproliferative inflammatory disease in which oxidative stress may play a pathogenetic role (11) (12). In chronic inflammatory disease (13), disturbances in the pro-oxidant and antioxidant balance favor the first, resulting in excessive formation of reactive oxygen species (ROS), such as superoxide (•O2) and hydrogen peroxide (H2O2) (14). Excessive ROS causes a variety of biological changes, including DNA alterations, increased lipid peroxidation, and the generation of inflammatory cytokines (15) (11). On the other hand, there is a lack of antioxidants that plays a role in the pathogenesis of psoriasis, as evidenced by a decrease in the antioxidants molecules essential for neutralizing the free radical load (16). As a result, an antioxidant molecule may be a viable therapeutic alternative.

 Coenzyme Q10 (CoQ10) ubiquinone, is a compound that is naturally present in the human body as a component of the electron transport chain in mitochondria (the major source of ROS) (17). Several studies have pointed out that CoQ10 can damage free radicals or even totally prevent the damages that may have resulted. Consequently, they improves energy, and build up the immune system (18).

Nevertheless, other factors have been noted that take part in the pathogenesis process of psoriasis: dermal, systemic expression of proinflammatory cytokines, especially interleukins (ILs), Tumor Necrosis Factor Alfa (TNFα) and Interferon Gamma (IFNγ), as well as a complex molecular interactions between epidermal keratinocyte, mononuclear leukocytes, neutrophil and activated T-cells (15). Adalimumab (Amgevita)® and Etanercept (Enbrel)® are anti-TNF agents that either bind to TNF, inhibiting receptor binding, or block TNF receptor activation. Advances in biotechnology have the potential to offer greater safety by developing drugs that interfere with specific targets in the pathogenesis of psoriasis. Both medications are currently accessible to treat psoriasis (19). The goal of this 12-week clinical experiment was to compare the percentage improvement in quality of life and psoriasis clinical severity in Iraqi psoriatic patients with persistent plaque psoriasis treated before and after adjuvant therapy with the biological agent Adalimumab in combination with CoQ10.

**Patients and Methods**

During the months of January to November 2021, a prospective double blind clinical trial for 38 patients with persistent plaque psoriasis and a clinical indication for biological treatment was conducted in the Department of Dermatology at Merjan Teaching Hospital in Babylon, Iraq. Only 24 patients successfully completed the study period out of the 38 who volunteered to participate in the experiment and signed a consent form approved by the local research ethics council. The participants with age range from 17 to 72 years old consisting nine women (37.5%) and 15 men (62.5%) were divided into two groups: a biological medicine (Adalimumab) and a placebo (corn starch) was given to Group A (n=11), while Group B (n=13) received 100 mg CoQ10 adjuvant therapy in addition to the biological medication already provided. The PASI score was used to determine the severity of the disease in all of the patients by the same dermatologist. In addition, patients were asked to complete a standardized quality of life questionnaire during a single appointment (DLQI). There were 10 questions in this tool, which were separated into six categories (symptoms and feelings, daily activities, leisure, job and school, personal connections, and psoriasis treatment discomfort). Each item is rated on a four-point scale, with alternatives such as 'not at all,' 'a little,' 'a lot,' and' very much.' The total score (9) (20) (21) is derived by combining the item scores together (22).

The biological treatment consisted of twice-monthly subcutaneous administration of 40 mg Adalimumab (Amgevita ®), a typical biological medication. After the 90thday of treatment, patients were reviewed and clinically evaluated by the same physician. Regardless of their present medical status, they all completed the same standardized questionnaire.

**Inclusion Criteria:** Patients with psoriasis vulgaris who have a PASI score higher than 10 were considered eligible.

**Exclusion Criteria:** Those with other chronic illnesses, such as diabetes mellitus, liver and renal problems, pregnant or breastfeeding participants and those under the age of 17 were eliminated.

**Statistical analysis**

The statistical software SPSS® version 25 for Windows was used to perform the statistical analysis. The data is presented in the form of mean values and standard deviation (SD). The Shapiro Wilk test was employed to ensure that the dependent variables' distributions were normal. The Wilcoxon test showed the differences in the means of two groups. Statistical significance was defined as Asymptotic Significance (2-tailed) at 0.05. For non-parametric data, Spearman's correlation and the Correlation tests (Spearman's correlation coefficient) were used for correlation analysis.

**Results**

Table (1) shows the demographic profile of patients who completed all questions satisfactorily at baseline and three months after the completion of treatment (n=24) . With an age range of 17 to 72 years, participant group A had a mean SD age of 44.13 $\pm $12.72 for males and 44.33$\pm $ 20.59 for females, whereas group B had a mean SD age of 44.71$\pm $ 8.19 for males and 30.17$\pm $ 12.64 for females.

 **Table (1): Descriptive Statistic for the Study Groups**

|  |  |  |  |
| --- | --- | --- | --- |
| **Group** | **Gender** | **N** | **Age (mean ±SD)** |
| **A** | Male | 8 | 44.13 ±12.72 |
| Female | 3 | 44.33 ±20.59 |
| **B** | Male | 7 | 44.71±8.19 |
| Female | 6 | 30.17±12.64 |

Table (2) shows mean PASI and DLQI scores, as well as mean percentage changes, for all patients enrolled in this study before and after treatment. The mean SD baseline PASI and DLQI scores were 20.88 $\pm $7.15 and 12.50 $\pm $4.72 for PASI and DLQI score, respectively. After 12 weeks of biological and adjuvant CoQ10 treatment, significant reductions in the two scores were reported to be (p 0.05). The mean percentage increase change using the PASI score was 67.48$\pm $ 22.25, while the DLQI score improved by 56.13$\pm $ 20.15, indicating a significant positive connection between the two scores (p 0.05).

**Table (2):** The Mean±SD PASI and DLQI Scores and Mean±SD Percentage Changes for all Patients Enrolled in this Study before and after Treatment

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Assessment Tool** | **N** | **Mean±SD****Before Treatment** | **Mean±SD****After Treatment** | **Asymptotic Significance** **(2-tailed)** | **Mean±SD****Percentage Improvement****Change** | **Asymp. Sig. (2-tailed)** |
| **PASI** | 24 | 20.88 ±7.15 | 7.08 ±6.68\* | .000 | 67.48 ±22.25a | .000 |
| **DLQI** | 24 | 12.5±4.72 | 5.50±3.20\* | 56.13±20.15 |

\* Statistically significant level before and after treatment. Asymptotic Significance (2-tailed) p < (0.05).

a Statistically significant level between PASI and DLQI percentage improvement changes p < (0.05).

Table (3) shows the mean SD PASI and DLQI scores and percentage changes for each group before and after therapy, revealing that both PASI and DLQI scores were significantly reduced after 12 weeks treatment (7.08$\pm $ 6.68, 5.50$\pm $ 3.20, respectively, p 0.05). After 12 weeks of treatment, the percentage improvement changes in PASI and DLQI for group A (getting biological therapy with placebo) were (45.71 $\pm $12.13, 36.67 $\pm $8.13), respectively. The percentage improvement for PASI and DLQI were (85.91$\pm $ 4.89, 72.60$\pm $ 9.07) when CoQ10 was used as adjuvant therapy in group B.

**Table (3):** The Mean±SD PASI and DLQI Scores and Mean±SD Percentage Changes for Each Group before and after Treatment

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Assessment Tool** | **N** | **Group A** | **N** | **Group B** |  |
| **Mean±SD****Before Treatment** | **Mean±SD****After Treatment** | **Mean±SD****Percentage Improvement****Change** | **Mean±SD****Before Treatment** | **Mean±SD****After Treatment** | **Mean±SD****Percentage Improvement****Change** | **Asymp. Sig. (2-tailed)** |
| **PASI** | 11 | 22.15±8.40 | 12.37 ±6.69 | 45.71± 12.13 | 13 | 19.80±6.04 | 2.61±0.92 | 85.91± 4.89a | 0.00 |
| **DLQI** | 11 | 12.73 ±4.79 | 7.91 ±2.66 | 36.67± 8.13 | 13 | 12.31±4.84 | 3.46 ±1.98 | 72.59± 9.07 | 0.00 |

a Statistically significant level between PASI and DLQI percentage improvement changes p < (0.05).



 \* Refers to difference in **PASI** mean between **group A & B.**

 # Refers to difference in **DLQI** mean between **group A & B.**

**Figure (1):** The Difference in Mean Percentage Improvement Changes of PASI and DLQI Scores Between group A and group B

Table (4) shows the association between PASI and DLQI scores before and after treatment, revealing a highly significant positive correlation (r=0.702, p=0.000132) between PASI and DLQI scores after 12 weeks of therapy. Before starting therapy, there was no discernible link between PASI and DLQI levels (r= 0.13, p=0.545). Changes in percentage improvement for both PASI and DLQI showed a highly significant association (r=0.696, p=.000161). Figures (2) and Table (3) shows the Spearman's correlation coefficients for the correlation between PASI and DLQI scores and percentage improvement changes after treatment time, respectively.

**Table (4):** The Correlation between Both PASI and DLQI Scores and Percentage Improvement Changes before and after Treatment

|  |  |  |
| --- | --- | --- |
| **Correlated variables** | **r** | **P-value** |
| PASI with DLQI Before treatment | 0.130 | 0.545 |
| PASI with DLQI After treatment | 0.702\*\* | 0.000132 |
| PASI with DLQI Improvement | 0.696\*\* | 0.000161 |

\*\*Correlation is highly significant (Spearman’s correlation coefficient) at the 0.01 level (2-tailed).



**Figure (2):** Correlation Between PASI and DLQI Scores After 12 Weeks Treatment



**Figure 3:** Correlation between PASI and DLQI Percentage Improvement Changesafter 12 Weeks Treatment

**Discussion**

The PASI and DLQI scores were used to examine the influence of changes in psoriasis severity on quality of life in patients with psoriasis at baseline and three months after treatment with biological therapy and an adjuvant CoQ10. Psoriasis has a detrimental impact on quality of life, and numerous research have shown how psoriasis severity affects quality of life (23)(24)(25). Although Psoriasis is a chronic, incurable condition, clinicians' primary goal is to enhance patients' quality of life, particularly those with severe psoriasis.

Dermatologists use the PASI score to assess psoriasis to obtain more objective clinical measures, but there are always limitations, such as the score calculation being complex, the affected area being subjective estimates, and most importantly, the scoring not taking into account the impact on the patient's quality of life (26).

The PASI and DLQI scores were calculated in this investigation. Before treatment with the biological therapy and an adjuvant antioxidant, there was no correlation between PASI and DLQI in both groups at baseline; however, after treatment with the biological therapy and an adjuvant antioxidant, both PASI and DLQI showed strong correlation and significant improvement in both scores when compared to baseline scores.

Regardless of treatment type, the percentage improvement change for PASI score was significantly higher than that for DLQI score at the end of treatment. This could be explained by the fact that DLQI as a measure of assessment is often influenced by social and cultural factors (9).

The severity of the disease and the long-term clinical course history of psoriasis symptoms, on the other hand, have a negative impact on DLQI due to psychological involvement in such patients, which further hampered their treatment compliance.

The findings of this investigation corroborated those of several earlier studies, which found a strong link between disease severity and quality of life (9)(27)(28)(37)(38). Other research, such as (6)(29), have found no link between PASI and DLQI (30).

Clinical investigations on psoriasis patients have showed that utilizing CoQ10 as an adjuvant therapy improves severity indicators and quality of life significantly (1)(34) (35).

In a study by Kharaeva et al. (35), fifty-eight psoriasis patients were treated with CoQ10 for one month and showed normalization of all oxidative stress markers produced by the blood and skin compartments, as well as improvements in skin structure and function. Biological therapies, alone or in combination with coenzyme Q10 supplements, may play a significant role in boosting the immune system and physical performance, the reason for this is that tissues and cells involved in immune function are highly energy-dependent, which is essential in powering the body's energy production ATP cycle, and thus require an adequate supply of CoQ10 for optimal performance.

We investigated the effect of Co-Q10 on the therapeutic value of biological therapy in psoriatic Iraqi patients in this study. When Coq10 was combined with a biological medicine, it resulted in a large decrease in PASI score as well as a significant increase in PASI and DLQI percentage improvement changes.

The findings of the above-mentioned studies clearly support the findings of this study; thus, it can be concluded based on the obtained results that administering CoQ10 (100 mg/day) as adjuvant therapy to psoriatic patients for 12 weeks had beneficial effects on the correlation between the PASI and DLQI after treatment with biological drugs.

I. Ethical approval:

The manuscript is written in original and all the data, results pertaining to this manuscript are original according to the research performed. The authors followed academic integrity and have not copied any content/results from another source.

II. Funding details (In case of Funding):

The authors of this manuscript did not receive any funding to perform the present research

III. Conflict of interest

The authors of the study do not have any conflict of interest

IV. Informed Consent:

The authors of the manuscript agrees to publish this research in the journal if it’s considerable by the editors of the journal. The authors provide full consent for reviewing and publishing this manuscript.

V. All the authors of this study contributed equally in terms of performing the research as well as in preparing the manuscript. All the authors of the study followed the guidelines of the corresponding author. Any query/suggestion related to the manuscript can be reached to the corresponding author

**References**

1.Guarneri et.al. Therapies with Antioxidant Potential in Psoriasis, Vitiligo, and,Lichen Planus. Review, Antioxidants 2021 ,10, 1087. https://doi.org/10.3390/antiox10071087.

2. Lima et al.. Psoriasis prevalence among the 2009 AAD National,Melanoma/Skin Cancer Screening Program participants. Journal of the European Academy of Dermatology and Venereology. 2012 DOI: 10.1111/j.1468-3083.2012.04531.

3.Griffiths CE, Christophers E, Barker JN, Chalmers RJ, Chimenti S, Krueger GG, et al. A classification of psoriasis vulgaris according to phenotype. Br J Dermatol. 2007;156(2):258-62. www.thelancet.com Vol 370 July 21, 2007 *Lancet* 2007

4. Al-Sultany et al **(** (2020): A-Sea. Assessment of serum zinc, copper and copper/zinc ratio in adult patients with psoriasis.Annals of Tropical Medicine & Public HealthS391 2020;Vol. 23 (I).

5. Sojević Timotijević *et al.*. The Impact of Changes in Psoriasis Area and,Severity Index by Body Region on Quality of Life,in Patients with Psoriasis. Acta Dermatovenerol Croat. 2017;25(3):215-222:215-22 Clinical artical.

6.Silva MFP et.al. . Psoriasis: Correlation between severity index (PASI) and quality of life index (DLQI) based on the type of treatment. Journal of Dermatology & Dermatologic Surgery. 2013,*DOI: http://dx.doi.org/10.1590/abd1806-4841.20132052*.

7.T.FREDRIKSSON and PETTERSSON. Severe Psoriasis -Oral Therapy With A New Retioid. Dermtologica. 1978 157:238-44.

8.Pariser DM. National Psoriasis Foundation,Clinical Consensus on Disease Severity. Arch Dermatol 2007;. 2007;143:239-242:239-42.

9. Al Raddadi, A. et.al. Psoriasis: Correlation between severity index (PASI) and quality of life index (DLQI) based on the type of treatment. Journal of Dermatology & Dermatologic Surgery. 2015, http://dx.doi.org/10.1016/j.jdds.2015.05.002

10.Finlay AY. Current severe psoriasis and the Rule of Tens. review article, British Journal of Dermatology 2005 2005;152:, pp861–7.

11.Winiarska-Mieczan A, Mieczan T, Wojcik G. Importance of Redox Equilibrium in the Pathogenesis of Psoriasis-Impact of Antioxidant-Rich Diet. Nutrients. 2020;12(6).

12.Al-Mokhtar et.al.. Leptin and Resistin Induce Oxidative Stress in Patients with Chronic Plaque Psoriatic. Journal of Pharmaceutical, Biological and Chemical Sciences · January 2017. 2017;8(1)(0975-8585):Page No. 135.

13.Sies B, and Dean P. Jones4. Oxidative Stress. Annu Rev Biochem 2017 2017;86:25.1–.34.

14. Y.Yang et.al... Reactive Oxygen Species in the Immune System. International Reviews of Immunology. 2013(0883-0185), DOI: 10.3109/08830185.2012.755176.

15.Zhou Q, Mrowietz U, Rostami-Yazdi M. Oxidative stress in the pathogenesis of psoriasis. Free Radic Biol Med. 2009;47(7):891-905.

16. Khmaladze et al.. Mannan induces ROS-regulated, IL-17A–dependent psoriasis arthritis-like disease in mice. IMMUNOLOGY AND INFLAMMATION. 2014;E3669–E3678, www.pnas.org/cgi/doi/10.1073/pnas.1405798111.

17.Kumar A, Kaur H, Devi P, Mohan V. Role of coenzyme Q10 (CoQ10) in cardiac disease, hypertension and Meniere-like syndrome. Pharmacol Ther. 2009;124(3):259-68.

18.Battino M et.al. OXIDATIVE INJURY AND INFLAMMATORY PERIODONTAL DISEASES: THE CHALLENGE OF ANTI-OXIDANTS TO FREE RADICALS AND REACTIVE OXYGEN SPECIES. Critical Reviews in Oral Biology & Medicine. 1999;10(4): :458-76, DOI: 10.1177/10454411990100040301

19.Lebwohl M. Psoriasis. ,Seminar.. THE LANCET • Vol 361 • April 5, (9364):1197-204, 2003 • www.thelancet.com

20. F.SAMPOGNA et al.. Prevalence of symptoms experienced by patients with different clinical types of psoriasis. British Journal of Dermatology. 2004;151: 594–9. DOI: 10.1111/j.1365-2133.2004.06093

21. E. Mazzotti et al.. Psychometric Properties of the Dermatology Life Quality Index (DLQI) in 900 Italian Patients with Psoriasis. Acta Derm Venereol. 2005(0001-5555). DOI: 10.1080/00015550510032832

22.J.Bhosle M.et.al. Quality of life in patients with psoriasis. Health and Quality of Life Outcomes 2006, Review. doi:10.1186/1477-7525-4-35, http://www.hqlo.com/content/4/1/35

23.SOJEVIC. Identification of psoriatic patients at risk of high quality of life impairment. Japanese Dermatological Association. 2013;40:: 797–804.

24. Gelfand et al Determinants of quality of life in patients with psoriasis: A study from the US population. American Academy of Dermatology,. 2004;2004;51:(5):704-8.).

25. H.L. Richards et al.. The contribution of perceptions of stigmatisation to disability in patients with psoriasis. Journal of Psychosomatic Research 2001;50:11-5. PII: S0022-3999(00)00210-5

26. [Navarini](https://pubmed.ncbi.nlm.nih.gov/?term=Navarini+AA&cauthor_id=24809878), et.al. Analysis of Body Regions and Components of PASI Scores During Adalimumab or Methotrexate Treatment for Patients With Moderate -to-Severe Psoriasis.

 J Drugs Dermatol 2014 May;13(5):554-62. doi: 10.36849/JDD.2020.4887

27.Reich K. and Christopher E. M. GriYths The relationship between quality of life and skin clearance in moderate-to-severe psoriasis: lessons learnt from clinical trials with infliximab. mini-review Arch Dermatol Res (2008) 300:537–544, DOI 10.1007/s00403-008-0885-7

28. S V Rakhesh, Mariette D'Souza, Ajith Sahai. Quality of life in psoriasis: a study from south India. Indian J Dermatol Venereol Leprol. 2008;Nov-Dec 2008,74(6):600-6:74(6):600-6. DOI:10.4103/0378-6323.45101

29. D,G,FORTUNE *etal*. Quality of life in patients with psoriasis: the contribution of clinical variables and psoriasis-specific stress. British Journal of Dermatology. 1997;1997; 137: :755-60.

30. *Yang* et al.. The psoriasis disability index in Chinese patients: contribution of clinical and psychological variables. International Journal of Dermatology. 2005. *International Journal of Dermatology*2005,**44**, 925–929. Report

31.Shijun Li et.al.. The Role of Cellular Glutathione Peroxidase Redox Regulation in the Suppression of Tumor Cell Growth by Manganese Superoxide Dismutase. American Association for Cancer. 2000. CANCER RESEARCH 60, 3927–3939, July 15, 2000]

32.Sahib A.S. The Effects of Coq-10 Supplementation on Oxidative Stress and Inflammatory Markers in Iraqi Type 2 Diabetic Patients. 2016;4(5).

33.Kim J, Kim K, Sung GY. Coenzyme Q10 Efficacy Test for Human Skin Equivalents Using a Pumpless Skin-On-A-Chip System. Article, Int. J. Mol. Sci. **2020**, 21, 8475; doi:10.3390/ijms21228475, www.mdpi.com/journal/ijms

34.Pagano et.al.. Current Experience in Testing Mitochondrial Nutrients in Disorders Featuring Oxidative Stress and Mitochondrial Dysfunction: Rational Design of Chemoprevention Trials. *Review,* International Journal of Molecular Sciences. 2014, *15*, 20169-20208; doi:10.3390/ijms151120169.

35. *Kharaeva et al.*. Clinical and biochemical effects of coenzyme Q10, vitamin E, and selenium supplementation to psoriasis patients. Nutrition. 2009;25(3):295-302.

36.Saini R. Coenzyme Q10, Letters, The Essential Nutrient. J Pharm Bioallied Sci. 2011;3(3):466-7. E-mail: drperiodontist@yahoo.co.in

37. M.K.A. Basra,et.al The Dermatology Life Quality Index 1994–2007: a comprehensive review of validation data and clinical results REVIEW ARTICLE, BJD British Journal of Dermatology, 2008 159, pp997–1035, DOI 10.1111/j.1365-2133.2008.08832.x

38. Revicki A,D,et.al. Relationship between Clinical Response to Therapy and Health-Related Quality of Life Outcomes in Patients with Moderate to Severe Plaque Psoriasis

Dermatology 2008;216:260–270 DOI: 10.1159/000113150