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Original Article

Serum zinc levels and their impact on quality of life of patients with atopic dermatitis

Luong Nguyen Dac Thuy[1*], Vu Thi Thuy Trang[2*], Doan Thi Phuong Thao[3], Pham Quoc Dung[3]

[1] University of Medicine and Pharmacy, Ho Chi Minh City, Vietnam.
[2] Tam Anh Hospital, Ho Chi Minh City, Vietnam.
[3] District 11 Hospital, Ho Chi Minh city, Vietnam.
[*] ***Authors 1 and 2 equally share first authorship.***

Abstract

Background Atopic dermatitis is a chronic, recurrent disease characterized by pruritus and eczematous lesions. Several studies have shown that atopic dermatitis severely affects the quality of life and atopic dermatitis patients have low serum zinc levels.

Objective This study aimed to evaluate the impact of atopic dermatitis on the quality of life and quantify the relationship between serum zinc levels and patients' well-being.

Methods Atopic dermatitis was diagnosed according to the Hanifin and Rajka criteria of 1980, and the severity was assessed using the Scoring Atopic Dermatitis (SCORAD) scale. The Dermatology Life Quality Index (DLQI) was used to evaluate the quality of life in patients. The itch severity was measured using the 5-D itch scale.

Results 87 patients and 87 controls participated in our study. The "itching" component had the highest DLQI score. A statistical correlation was observed between the SCORAD score and the DLQI score. In the patient group, the serum zinc levels were lower than that in the control group. Additionally, negative correlations between the SCORAD scores, the DLQI scores, and the 5-D scores against serum zinc levels were observed.

Conclusion Atopic dermatitis is associated with low serum zinc levels; both have a major impact on patients' quality of life.

Key words
Atopic dermatitis; DLQI; Pruritus; Quality of life; Serum zinc levels.

Introduction

Atopic dermatitis is a chronic, recurrent inflammatory skin disease. It occurs at all ages, but it usually starts in childhood and is associated with allergic diseases such as allergic rhinitis and asthma.[1] The prevalence of atopic dermatitis varies between countries, and children are the most affected age group, with 15–20% being affected; for adults, this figure is one to three percent.[2] The duration of this disease is usually prolonged from childhood onward; adult-onset cases are rare. As it is chronic and recurrent, atopic dermatitis has a significant impact on the quality of life of patients. Prolonged itching and pain can disrupt daily activities and interfere with sleep.[3] In the long term, this can lead to psychological changes and even depression. Furthermore, atopic dermatitis causes disfigurement, which greatly affects patients' self-perception, diminishes their confidence and causes anxiety.[4] Therefore, evaluating patients' quality of life is a practical step in the management of patients with atopic dermatitis.[5]

Address for correspondence
Vu Thi Thuy Trang
Tam Anh Hospital, Ho Chi Minh City,
Postal address: 70000, Vietnam.
Ph: +84796592638
Email: trangvtt2@tahospital.vn

In recent decades, the role of zinc in atopic dermatitis has increasingly been recognized. According to a meta-analysis of Gray *et al;* atopic dermatitis patients have lower serum, hair, and erythrocyte zinc levels in comparison to healthy controls.[6] However, there has been no study measuring the correlation between serum zinc concentrations and the quality of life of atopic dermatitis patients. Therefore, we conducted this study to determine the impact of atopic dermatitis on the quality of life of patients in Vietnam and identify its relationship with the serum zinc levels. This research may contribute to the efforts to develop strategies that can enhance atopic dermatitis patients' quality of life, prevent disease progression, and limit the psychological influence.

Methods

Patients who visited the Department of Dermatology of District 11 Hospital from April 2020 to September 2022 and met the diagnostic criteria for atopic dermatitis (based on the revised Hanifin and Rajka criteria of 2003) were included in the study. Patients using oral zinc in the last three months, being pregnant, having strict diets, body mass index below 18.5, severe systemic illnesses, or any diseases related to zinc deficiency were excluded. The medical histories of patients, including the history of allergic diseases like allergic rhinitis, asthma, and allergic conjunctivitis, were acquired. The severity of the disease was determined based on the Scoring Atopic Dermatitis (SCORAD) scale; accordingly, the patients were classified as having mild (<25), moderate (25–50), or severe (>50) atopic dermatitis.[7] The quality of life of patients with atopic dermatitis was assessed using the Dermatology Life Quality Index (DLQI).[8] If the DLQI score is high, the quality of life is low, and vice versa. In the control group, healthy volunteers matched for age and sex were chosen. We determined the serum zinc level in two ml of peripheral blood using atomic absorption spectrophotometry. The itch severity was measured using 5-D itch scale.[9]

The Board of Ethics of District 11 Hospital approved our study, with approval number CS/11/20/01, and informed consent was obtained from all participants. Our procedure was in compliance with the ethical standards of the institutional committee on human experimentation and with the Declaration of Helsinki of 1975, as revised in 2013.

The data were analyzed using STATA software (version 15). Analysis of variance (ANOVA), Student's t-test and Mann-Whitney U test were employed to identify the difference between the mean values of normally and abnormally distributed groups. For the correlation between dependent variables, Pearson correlation was applied. A P-value ≥0.05 was considered insignificant.

Results

Eighty seven patients and 87 healthy individuals participated in this study. Our patients' age had a mean±standard deviation (SD) value of 47±16.71. Males accounted for 40% of all patients, while females accounted for 60%. Patient group and control group showed insignificant difference in terms of age or gender. Sixty-one percent of all patients had a history of allergies.

The SCORAD scores of the patients had a mean±SD value of 29.63±11.60; 40% of them presented with mild atopic dermatitis, 55% with moderate atopic dermatitis, and only five percent with severe atopic dermatitis.

The variable with the highest score (mean±SD) in the DLQI was "itching" (1.78±0.83). "Sexual difficulties" was the least affected variable (0.22±0.6).

Table 1 The DLQI scale.

	DLQI score (Mean ± SD)	*P**
Total score (Mean ± SD)	7.63 ± 6.61	
Gender		
Male (n = 35)	8.29 ± 7.00	0.35
Female (n = 52)	7.19 ± 6.37	
Age		
≤ 25 (n = 16)	13.13 ± 8.62	0.005
> 25 (n = 71)	6.39 ± 5.42	
Age of onset		
≤ 25 (n = 17)	12.88 ± 8.40	0.003
> 25 (n = 70)	6.36 ± 5.45	
History of allergies		
Absent (n = 34)	5.56 ± 4.79	0.03
Present (n = 53)	8.96 ± 7.29	

DLQI, Dermatology Life Quality Index; N = Number; SD = Standard deviation; * Wilcoxon–Mann–Whitney test.

Table 2 Correlation between the DLQI and SCORAD scores.

DLQI	*R **
All (n = 87)	0.32 (P = 0.003)
History of allergies	
Absent (n = 34)	0.34 (P = 0.05)
Present (n = 53)	0.31 (P = 0.03)

DLQI, Dermatology Life Quality Index.
*Spearman's correlation.

As demonstrated in **Table 1**, no significant difference in DLQI scores was found between genders. However, in two different age groups and age-of-onset groups, significant differences were observed. In terms of concomitant atopic diseases, patients with a history of allergies had significantly higher total scores than those with only atopic dermatitis.

According to **Table 2**, the Spearman's correlation coefficient for the comparison between the objective SCORAD scores and the total DLQI scores was 0.32 (P=0.003). Furthermore, only in patients with a history of allergic diseases, the SCORAD scores were positively correlated with the DLQI scores.

The serum zinc levels in the patients had a mean±SD value of 82.64±15.54 µg/dL. Meanwhile, the mean±SD value of the serum zinc concentrations of healthy people was 88.72±15.16 µg/dL; the difference was significant (P=0.01).

The mean±SD 5-D score obtained in our study was 9.75±3.29 with scores ranging between 5 and 21. Additionally, there was a negative correlation between SCORAD scores, DLQI scores and 5-D scores against serum zinc levels (r =-0.34, -0.27, -0.30, respectively) **(Figures 1-3)**.

Finally, the serum zinc concentrations of patients from different groups (age, age of onset, and history of allergies) were analyzed; no significant differences were observed (data not shown).

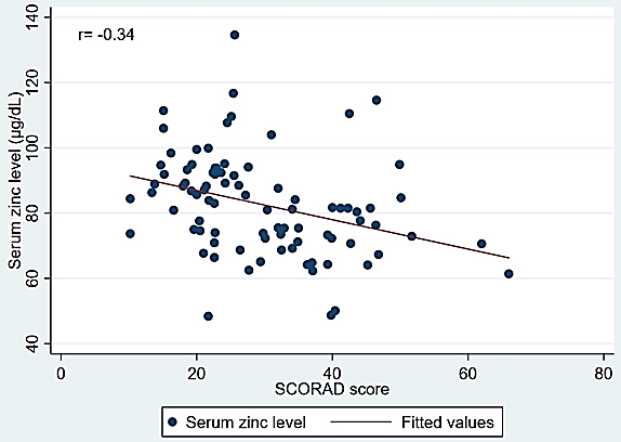

Figure 1 The correlation between SCORAD scores and serum zinc levels.

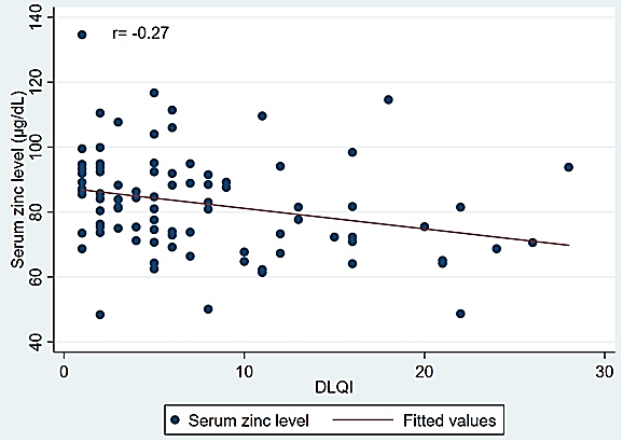

Figure 2 The correlation between DLQI scores and serum zinc levels.

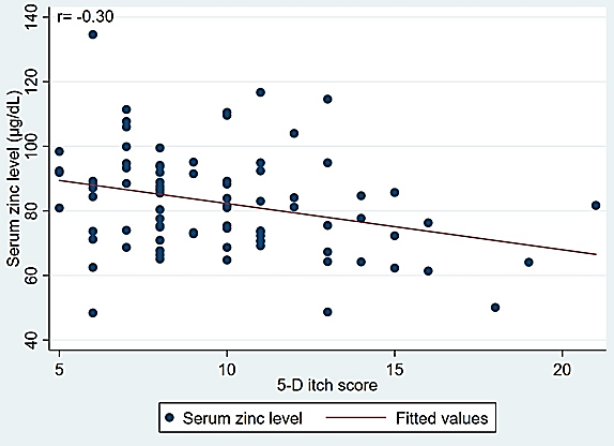

Figure 3 The correlation between 5-D itch scores and serum zinc levels.

Discussion

Atopic dermatitis is a chronic, relapsing inflammatory skin disease. It is estimated to impact one in ten people in their lifetime.[10] Quality of life of patients with atopic dermatitis is often markedly impaired. In our study, itching was the quality-of-life issue that was most commonly affected; personal relationships were not hindered. Kim *et al*. formed similar conclusions from their data on 147 adults with atopic dermatitis, in which "itching" was the most affected component (1.7±0.9), while "sexual difficulties" was the least influenced one (0.5±0.8).[11] This could be because pruritus is prominent in atopic dermatitis, leading to fatigue, insomnia, emotional changes, depression, and suicidal ideation; this may severely compromise a patient's quality of life.[12-14]

In our study, the DLQI score for patients aged ≤25 years was statistically significantly higher than that for patients aged >25 years. Similarly, regarding the age of onset, the quality of life of patients with an age of onset >25 was significantly better than that of the other patients. This may be because the pre-frontal cortex, which is responsible for planning, judgment, and reasoning, is not fully developed until 25.[15] If the prefrontal cortex is not fully developed, people may not be capable of discerning their health conditions accurately and may make poor decisions, leading to a lower quality of life. Furthermore, for those in the younger age group, their relationships may be not stable, and their social status is usually not high; consequently, their quality of life may be negatively affected more easily compared to their older counterparts.

We also found a positive correlation between the SCORAD and DLQI scores. This result is in line with the outcome of Linnet *et al*.'s study in which these scores were correlated positively (r= 0.54, P <0.001).[16] These findings support the hypothesis that the more severe the disease is, the more impaired the patients' quality of life is. Similarly, according to Servando *et al;* the use of Dupilumab, a monoclonal antibody against IL-4 in atopic dermatitis, resulted in a decrease in both the SCORAD scores and the DLQI scores after 52 weeks; this difference was statistically significant.[17]

Further analysis after subdividing the patients into those with and those without a history of allergic diseases indicated that the DLQI scores for the former group were significantly higher (P=0.03) than that of the latter group, and only in the former group, a significant positive correlation between the DLQI and SCORAD scores was noted. A similar conclusion was drawn by Kim *et al*. who determined that patients with concomitant asthma, allergic rhinitis, or allergic conjunctivitis had lower quality of life than patients with only atopic dermatitis.[11] The symptoms of asthma and allergic rhinitis such as cough, wheezing, shortness of breath, stuffy nose, and runny nose may also contribute to worsening patients' quality of life.

Our study demonstrated that atopic dermatitis

patients have significantly lower serum zinc levels compared to healthy individuals, which provides support for the conclusion of Gray *et al*. in which low serum zinc levels have a connection with atopic dermatitis.[6] Furthermore, patients with higher SCORAD scores had lower serum zinc levels, which in line with a study by Farhood *et al*.[18] The author concluded that there is a negative correlation between serum zinc levels and severity of atopic dermatitis. According to Prasad *et al;* zinc deficiency may lead to a shift from T Helper 1 to T Helper 2 functions, and T Helper 2 plays a key role in the pathogenesis of atopic dermatitis.[19,20] Furthermore, stress and activation of macrophages–monocytes which are attributed to zinc deficiency increase the levels of inflammatory cytokines (interleukin (IL)-1b, IL-6, IL-8, tumor necrosis factor alpha,…) and may contribute to the symptoms of atopic dermatitis.[19] Similar results were obtained in the experiment by Takahashi *et al*.[21] In that study, mice fed the zinc deficient diet had elevated serum immunoglobulin E levels, increased number of Staphylococcus aureus on the skin surface and exacerbated skin eruptions. These authors concluded that zinc deficiency impairs not only the skin barrier but also the immune system, thus acting as a risk factor for exacerbation of atopic dermatitis.

We also found a significant negative correlation between serum zinc level and 5-D itch scores and DLQI scores. According to Takai *et al;* varicose vein patients with itching had lower serum zinc concentration compared to other patients and healthy individuals.[22] Moreover, in that study, patients with low serum zinc had high transepidermal water loss and low stratum corneum water content, suggesting that with low serum zinc concentrations, the skin barrier function is decreased, triggering the itch-scratch cycle which is a feature of atopic dermatitis. Furthermore, itchy dialysis patients with lower serum zinc had higher histamine levels, one of the most explored pruritogens.[23] In a case-control trial, after 8 weeks of zinc supplement, the severity of atopic dermatitis, transepidermal water loss, and visual analogue scales for pruritus improved more in the treatment group than in control group.[24] All of these outcomes consolidate our findings.

Conclusion

Low serum zinc levels in atopic dermatitis patients, especially severe ones, severely affect their quality of life and may have a role in the pathogenesis of pruritus. Further in-depth studies are warranted to assess the impact of zinc deficiency on atopic dermatitis more accurately and to determine the effectiveness of zinc therapy in those patients.

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