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Research Article

Oxidative stress state in patients with atopic Eczema in Anbar Governorate

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Abstract

Atopic Eczema commonly known as atopic dermatitis (AD), is a form of inflammatory skin condition that impairs the skin barrier and its capacity to retain moisture, it is the most prevalent chronic skin condition and is inherited. Although AD can affect people of all ages, it most often first manifests in infancy and early childhood. (AD) a varied, complex chronic inflammatory skin condition, Atopic dermatitis is thought to arise for a variety of reasons, including genetic factors connected to filaggrin malfunction. Both its duration and its onset in maturity are possibilities, Patients are affected by the intense itching of the disease, which commonly results in skin injuries and major sleep problems, as well as the social shame attached to having a visible skin ailment. Through the activation of genes that code for proinflammatory cytokines, oxidative stress encourages tissue inflammation. Free radicals are then released when inflammatory cells are activated. Given AD's strong inflammatory underpinning, Since oxidative stress has been shown to have a major role in skin aging, it is likely that it contributes to the genesis of the illness. Researching the correlation between oxidative stressors including MDA, SOD, and T-AOC, as well as inflammation, is crucial in Alzheimer's disease. We enrolled 75 patients divided into (25 infants, 25 children, and 25 adults) with AD and 51 healthy controls divided into (17 infants, 17 children, and 17 adults) individuals who did not have the disease and had no history of AD. We measure serum (Malondialdehyde MDA, Superoxide dismutase SOD, and Total antioxidant capacity T-AOC). Serum (MDA) levels were significantly increased in AD patients compared to controls, and Serum (SOD and T-AOC) levels were significantly decreased in AD patients compared to controls.

Keywords: atopic dermatitis/eczema, Superoxide dismutase, total antioxidant capacity, Oxidative stress

Introduction

Eczema, commonly known as atopic dermatitis (AD), represents an inflammatory skin condition impacting the skin barrier and its moisture retention capacity. As the most prevalent chronic skin condition with a hereditary basis (Thomson et al., 2018), individuals with AD bear a substantial burden affecting economic, social, psychological, and physical well-being. Despite recent advancements in understanding and treating the disease, there remains a crucial need for innovations and improved therapy accessibility. Many patients struggle to control their condition, with over 70% experiencing spontaneous remission before adolescence (Nutten, 2015). Atopic dermatitis is multifactorial, influenced by genetic factors linked to filaggrin malfunction (Drislane & Irvine, 2020). Environmental, genetic, and immunologic variables collectively determine AD prevalence (Grafanaki et al., 2023). The clinical spectrum of AD spans various phenotypes in terms of clinical features, severity, course, patient age, and ethnicity (Volke et al., 2022). Symptoms encompass chronic itching, cutaneous discomfort, lichenification, excoriation, dryness, and depigmentation (Oykhman et al., 2022), categorized into three clinical patterns: acute, sub-acute, and chronic (Silvestr et al., 2017; Seghers et al., 2014). Major triggers contributing to AD include environmental factors, airborne pollutants, harsh detergents, fragrances, and preservatives (David et al., 2017). A strong association exists between AD and oxidative stress, where an imbalance in reactive oxygen species (ROS) and reactive nitrogen species (RNS) contributes to the pathophysiology of the disease (Hayes et al., 2020; Boonla, 2018). Oxidative stress arises from mental and physical strain and can result in skin damage, with malondialdehyde (MDA) serving as a crucial biomarker for lipid peroxidation and oxidative stress imbalance (Nomani et al., 2018). Superoxide dismutase (SOD), an antioxidant enzyme defending against free radicals (FRs), plays a vital role in AD and other allergy disorders, potentially regulating similar pathologies (Stephenie et al., 2020). Oxidative stress disrupts skin homeostasis, impairs the skin barrier, and triggers inflammation, contributing significantly to AD exacerbations (Sivaranjani et al., 2013; Sah et al., 2018). Total antioxidant capacity (T-AOC), measuring FR removal and antioxidant capacity, serves as an integrated metric providing insights into oxidative stress and risk (Rubio et al., 2016; Abdel Aziz et al., 2021). This study aims to assess serum levels of oxidative stress indicators (MDA, SOD, and T-AOC) and their adoption as pathological markers for AD in the Anbar Governorate environment.

Martial and methods

The Fallujah Maternity and Children Hospital's laboratory served as the study's location from

December 2022 to June 2023. There were 52 control subjects and 75 cases in the research. The study comprised 17 healthy infants, ages ranging from 1 to 24 months; 17 healthy children; ages ranging from 2 to 12 years; and 17 healthy adults, ages ranging from 12 to 68 years, who were disease-free. Additionally, 25 patients' newborns, whose ages varied from 1 to 24 months, and 25 patients' children, whose ages ranged from 2 to 12 years, were included in the study. and there were 25 adult patients, whose ages ranged from 12 to 68. Based on a favorable diagnostic, doctors diagnosed the patients with atopic eczema. They collected from the Al-Anbar governorate. They were collected from the AL-Anbar governorate. Every patient filled out an extensive form with their name, age, gender, the location of the injury on their body, and their past medical history. Every patient verbally consented to take part in this investigation. Five milliliters of the participants' blood were carefully extracted from their veins and put into inexpensive, disposable tubes. Venous blood samples were collected using gel tubes. Serum samples were produced by centrifuging samples in gel tubes for ten to fifteen minutes at 3000 rpm after they had been allowed to coagulate for ten to fifteen minutes at 37°C. The samples were then divided into four sections and stored at -20°C until biochemistry analysis. The following parameters were measured using the ELISA technique serum levels of (SOD, MDA) Elabscience (USA), While serum levels of (T-AOC) Sun Long Biotech Co.LT (China). The results were presented as mean ± SD after the data were analyzed using linear regression analysis. A statistical analysis was performed using SPSS version 23.0. The threshold for statistical significance was set at $p < 0.05$.

Results

1) MDA (ng/ml): the results showed a significant increase in the infant group ($p < 0.001$) patients (833.456± 226.409) than in the control group (651.963±176.643). In the children group, the results showed a significant increase ($p < 0.001$) in patients (1130.168 ± 429.988) than in the control group (703.436± 89.410) Also in the adults group, the results showed a significant increase ($p < 0.001$) in patients (1348.808 ± 367.937) than in the control group (866.441±173.993). 2) SOD (pg/ml): the results showed a significant increase in the infant group ($p < 0.001$) patients (136.033 ± 35.751) than in the control group (154.978 ± 37.511). And in the children group, the results showed a significant increase ($p < 0.001$) in patients (67.281 ± 20.701) than in the control group (156.309 ± 43.295). Also in the adults group, the results showed a significant increase ($p < 0.001$) in patients (63.943 ± 15.486) than in the control group (156.371± 52.311); 3) T-AOC (U/ml):

the results showed a significant decrease in infants group($p < 0.001$) in patients (35.162 ± 6.604) than in the control group (28.902 ± 8.288). And in the children group, the results showed a significant decrease ($p < 0.001$) in patients (13.992 ± 4.679) than in the control group (26.341 ± 10.529). Also in the adults group, the results showed a significant decrease ($p < 0.001$) in patients (18.058 ± 5.894) than in the control group (33.447 ± 10.852). The result is shown in Tables 1,2 and 3 as well as Figures 1, 2, and 3.

Table 1. Mean ± Standard deviation MDA concentration in sera of Atopic Eczema patients and control group

MDA (ng/mL)	**Control**	**Patient**	***P*-value**
	Mean ± SD	**Mean ± SD**	
Infants	651.963±176.643	833.456± 226.409	0.001
Children	703.436± 89.410	1130.168 ± 429.988	0.001
Adults	866.441±173.99	1348.808± 367.937	0.001

Table 2. Mean ± Standard deviation SOD concentration in sera of Atopic Eczema patients and control group

SOD (ng/mL)	**Control**	**Patient**	**P-value**
	Mean ± SD	**Mean ± SD**	
Infants	154.978 ±37.511	136.033 ± 35.751	0.001
Children	156.309 ±43.295	67.281 ± 20.701	0.001
Adults	156.371± 52.311	63.943 ± 15.486	0.001

Table 3. Mean ± Standard deviation T-AOC concentration in sera of Atopic Eczema patients and control group

(TAC) (ng/mL)	**Control**	**Patient**	**P-value**
	Mean ± SD	**Mean ± SD**	
Infants	28.902 ± 8.288	35.162 ± 6.604	0.001
Children	26.341±10.529	13.992 ± 4.679	0.001
Adults	33.447 ± 10.852	18.058 ± 5.894	0.001

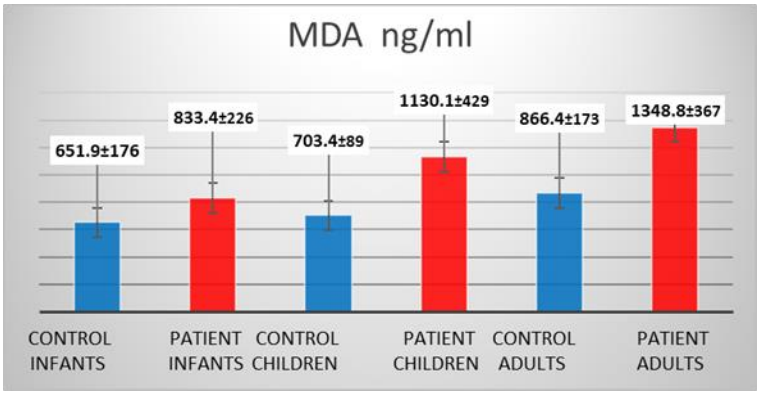

Figure 1. Mean ± Standard Deviation MDA concentration in Atopic Eczema patients and control group

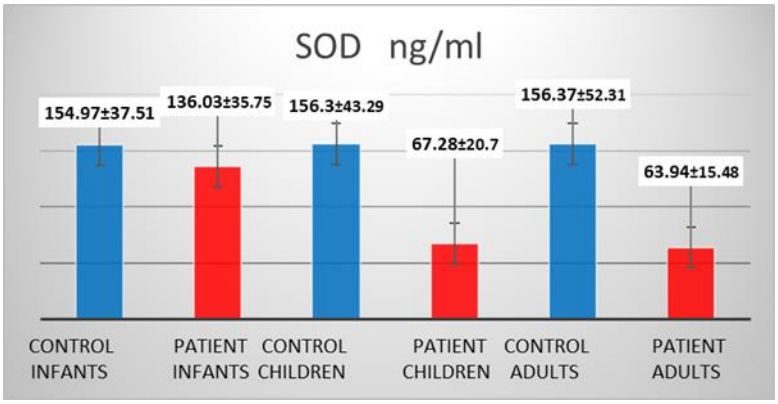

Figure 2. Mean ± Standard Deviation SOD concentration in Atopic Eczema patients and control group

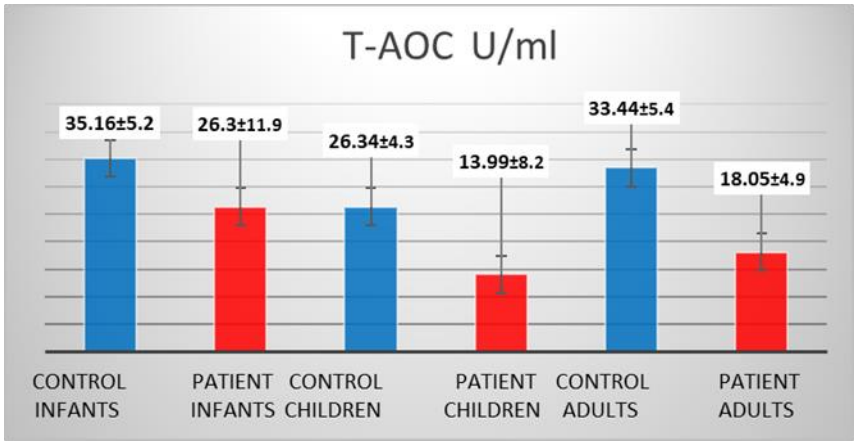

Figure 3. Mean ± Standard Deviation T-AOC concentration in Atopic Eczema patients and control group

According to Pearson's infant analysis. The findings of linear regression analysis demonstrate that there is a weak negative association < 0.05, r = (-0.415) of serum (T-AOC) concentration with (MDA), while this study showed a non-significant correlation between (MDA and SOD)

concentration with (MDA) respectively, in the atopic eczema patient infants group. These correlations are shown in Table 4, and Figures 4 and 5.

Table 4. Correlation between MDA with (SOD and T-AOC) in the atopic eczema patient infants group

Parameters	Correlation coefficient R	P-value
SOD (pg/mL)	-0.241	0.111 N.S
T-AOC (ng/mL)	-0.415	0.005

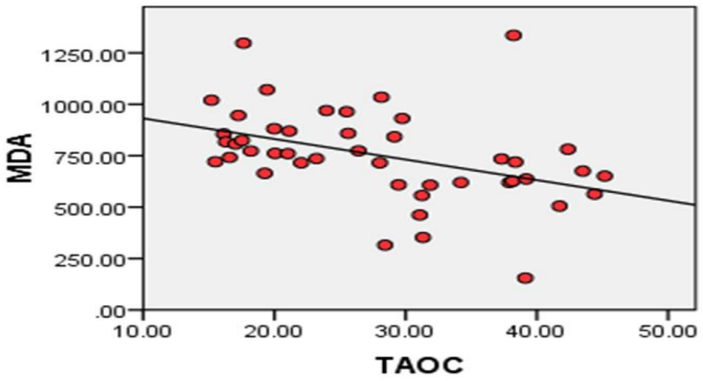

Figure 4. Correlation between MDA with T-AOC in the Atopic Eczema patient infants group

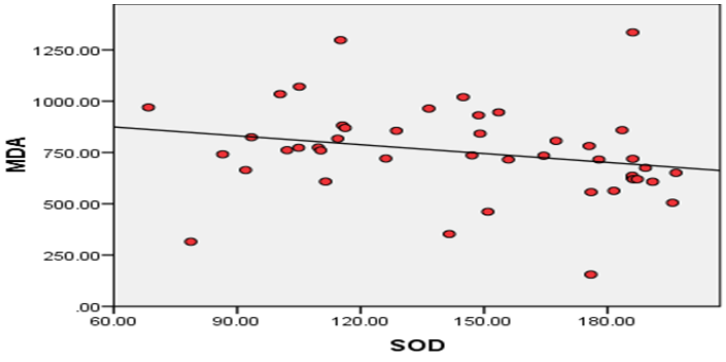

Figure 5. Correlation between SOD with MDA in the Atopic Eczema patient infants group

(Also the findings of linear regression analysis demonstrate that there is a strong positive association $p < 0.05$, $r = (0.703)$ of serum (T-AOC) concentration with SODin the atopic eczema patient infants group. These correlations are shown in Table 5 and Figure 6.

Table 5. Correlation between SOD with (T-OAC) in the atopic eczema patient infants group

Parameters	Correlation coefficient R	P-value
T-AOC (ng/mL)	0.703	0.001

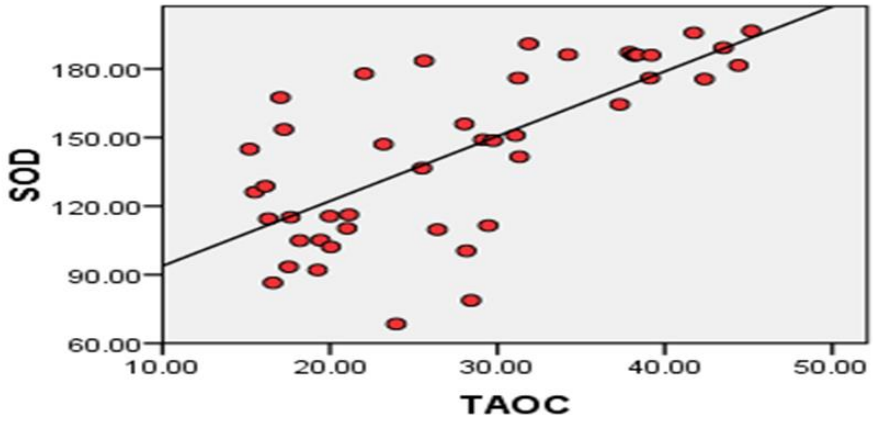

Figure 6. Correlation between SOD with T-AOC in the Atopic Eczema patient infants group

Also, the findings of linear regression analysis demonstrate that there is a strong negative association $p < 0.05$, $r = (- 0.549)$ of serum (SOD) concentration with (MDA), and a weak negative association $p < 0.05$, $r = (-0.337)$ of serum (T-OAC) concentration with (MDA) in the atopic eczema patient children group. These correlations are shown in Table (6), and Figure (7 and 8).

Table 6. Correlation between MDA with (SOD and T-AOC) in the atopic eczema patient children group

Parameters	Correlation coefficient R	P-value
SOD (pg/mL)	-0.549	0.001
T-AOC (ng/mL)	-0.337	0.024

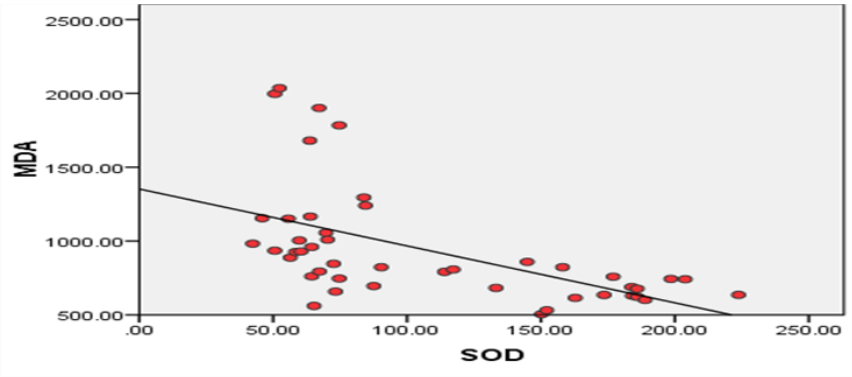

Figure 7. Correlation between SOD with MDA in the Atopic Eczema patient children group

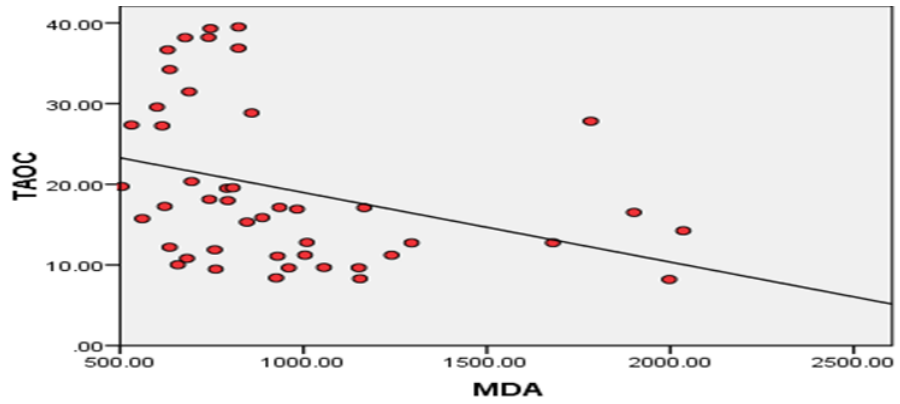

Figure 8. Correlation between MDA with T-AOC in the Atopic Eczema patient children group

The results of the linear regression analysis revealed a robust positive association, with statistical significance ($p < 0.05$) and a correlation coefficient (r) of 0.591, indicating a strong relationship between serum total antioxidant capacity (T-AOC) concentration and superoxide dismutase (SOD) in the group of children with atopic eczema. Detailed correlations are presented in Table 7, and a visual representation can be found in Figure 9.

Table 7. Correlation between SOD with (T-OAC) in the atopic eczema patient children group

Parameters	Correlation coefficient R	P-value
T-AOC (ng/mL)	0.697	0.001

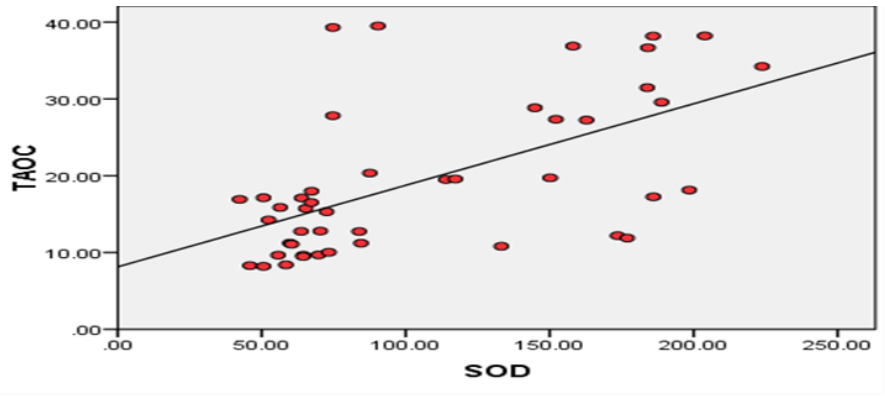

Figure 9. Correlation between SOD with T-AOC in the Atopic Eczema patient children group

The findings of this study indicate, through linear regression analysis, a weak negative association ($p < 0.05$, $r = -0.431$ for SOD and -0.405 for T-AOC) between serum concentrations of superoxide dismutase (SOD) and total antioxidant capacity (T-AOC) with malondialdehyde (MDA) in the adult group of patients with atopic eczema. These correlations are presented in Table 8, and visual representations can be found in Figures 10 and 11.

Table 8. Correlation between MDA with (SOD and T-AOC) in the atopic eczema patient adults group

Parameters	Correlation coefficient R	P-value
SOD (pg/mL)	-0.431	0.003
T-AOC (ng/mL)	-0.405	0.006

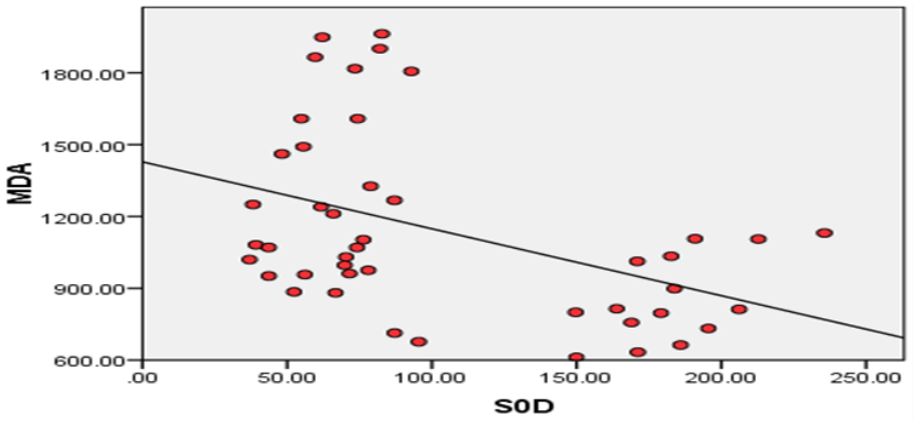

Figure 10. Correlation between SOD with MDA in the Atopic Eczema patient adults group

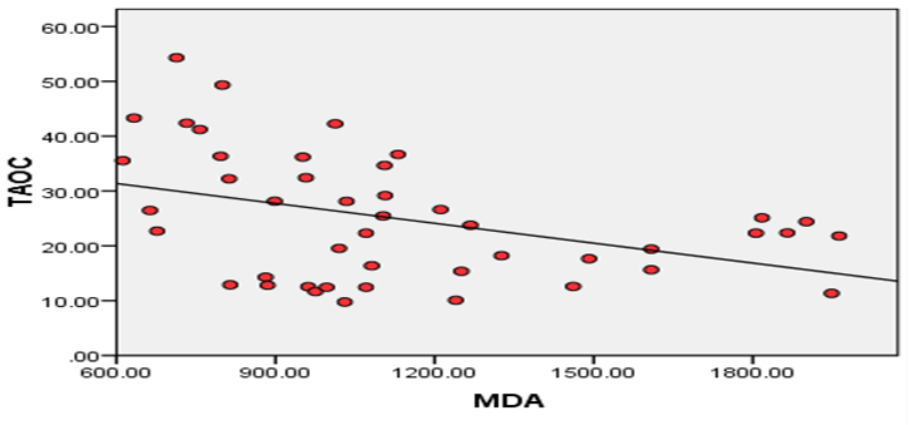

Figure11. Correlation between MDA with T-AOC in the Atopic Eczema patient adults group

The study results indicate, through linear regression analysis, a robust positive association ($p < 0.05$, $r = 0.604$) between serum total antioxidant capacity (T-AOC) concentration and superoxide dismutase (SOD) in the adult group of patients with atopic eczema. These correlations are detailed in Table 9, and a graphical representation is provided in Figure 12.

Table 9. Correlation between SOD with (T-OAC, and Vit. E) in the atopic eczema patient adults group

Parameters	Correlation coefficient R	P-value
T-AOC (ng/mL)	0.690	0.001

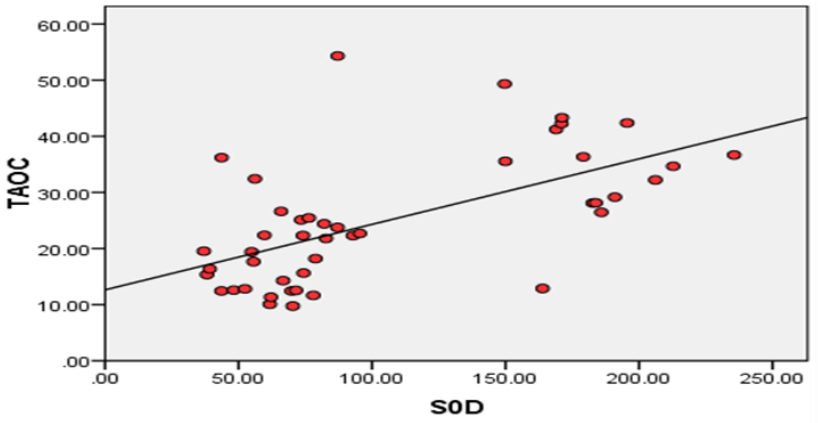

Figure 12. Correlation between SOD with T-AOC in the Atopic Eczema patient adults group

Malondialdehyde (MDA) stands out as a recommended indicator of oxidative stress. Recognized within the Biomarker Oxidative Stress (BOS), MDA, a byproduct of lipid peroxidation, serves as a reliable biological indicator of oxidative stress. Various methods, including MDA measurement, are employed to assess

oxidative stress levels (Decroli et al., 2019; Tsukahara et al., 2003; Park, 2014). Demonstrated as a key indicator, MDA plays a pivotal role in signaling oxidative stress and lipid damage resulting from free radicals (Perkins et al., 2001). In the study conducted by N. Sivaranjani et al., elevated levels of lipid peroxidation, as measured by malondialdehyde (MDA), were observed in patients with atopic dermatitis (AD) (Sivaranjani et al., 2013). Our research supports the findings of Hirokazu Tsukahara et al., confirming that the pathogenesis of acute exacerbations in AD involves oxidative stress and a compromise in antioxidant defenses, as evidenced by increased MDA levels in AD patients (Tsukahara et al., 2003). Additionally, Mohammad Nurul Amin et al. reported increased MDA levels along with decreased antioxidant levels in some cases, suggesting a potential contributing factor to the development of eczema (Amin et al., 2015). Superoxide dismutase (SOD), the main enzyme responsible for neutralizing free oxygen radicals, plays a crucial role in mitigating oxidative damage (Daniluk et al., 2019). Our study aligns with previous research, proposing that SOD could manage AD and other allergic disorders with similar pathology (Sivaranjani et al., 2013). Oxidative stress emerges as a significant factor in AD exacerbations, disrupting skin homeostasis, compromising skin barrier function, and inciting inflammation (Sah et al., 2018). Studies by Shanthy Devadasan et al., Y. Niwa et al., and Lucrezia Bertino et al. further substantiate our findings, indicating lower SOD levels in AD patients compared to healthy controls (Devadasan et al., 2020; Niwa et al., 2003; Bertino et al., 2020).

Total antioxidant capacity (T-AOC), described as the overall antioxidant activity in plasma and bodily fluids, serves as an integrated metric providing a comprehensive assessment of antioxidant balance (Ghiselli et al., 2000). Our results are consistent with studies by Sabina Galiniak et al. and Alaa Jaheen et al., revealing a substantial decrease in T-AOC levels in the blood of AD patients compared to healthy controls (Galiniak et al., 2022; Jaheen et al., 2022). Gref et al.'s findings suggest a potential reduction in the likelihood of allergen sensitivity with increased T-AOC in early school age aligns with our results (Gref et al., 2017).

Conclusion

Our study establishes a positive correlation between MDA and AD while noting an adverse correlation between SOD, T-AOC, and AD. Individuals with higher MDA levels and inadequate SOD and T-AOC may be more predisposed to developing and progressing with AD. Thus, serum MDA, SOD, and T-AOC could serve as valuable diagnostics for forecasting the development and progression of AD.

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