

## Colonization With Methicillin Resistant and Methicillin Sensitive *Staphylococcus aureus* Subtypes in Patients With Atopic Dermatitis and Its Relationship With Severity of Eczema

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### ABSTRACT

**Background:** Studies revealed that severity of atopic dermatitis correlates with colonization by *S.aureus* and the density of bacteria and antibiotic resistance is one of the factors in *S.aureus* recolonization.

**Objectives:** We aimed to determine the pattern of colonization with different subtypes of *S.aureus* in patients with atopic dermatitis and its correlation with SCORAD (Scoring Atopic Dermatitis) index.

**Materials and Methods:** We studied 114 sample cultures from normal skin, nose and active lesions of 38 patients with atopic dermatitis to detection of *Staphylococcus aureus* colonization and MRSA (methicillin resistance *Staphylococcus aureus*) subtypes with E test. The severity of the disease was identified by the SCORAD criteria. Logistic regression analysis was used for the evaluation of the coexistence between MRSA colonization and SCORAD index in these patients.

**Results:** We studied 114 sample cultures from 38 children (73% boys, 27% girls) with atopic dermatitis. Mean age of the patients was 19 ± 22.7 months. Mean objective SCORAD was 37.8 + 16.4 (range: 15-80). Twelve patients (31.6%) had mild, 18 patients (47.4%) had moderate and 8 patients (21%) had severe SCORAD.

Seventeen patients (44%) were colonized by *S. aureus* in the nose, 14 (36%) on skin lesions, and 8 (21%) on healthy skin. Among all the cultures, MSSA was noted in 26 (22%) and MRSA was noted in 13 (11%). There was a significant relationship between SCORAD index and colonization of nose and active lesions with *Staphylococcus aureus* (P value = 0.001). We found MRSA only in patients with moderate SCORAD.

**Conclusions:** This study shows lower rate of *S. aureus* colonization in atopic dermatitis cases but similar rate of MRSA colonization in comparison with previous studies. A higher rate of MRSA colonization was found in patients with moderate SCORAD.

**Keywords:** Dermatitis; Atopic; Eczema; Methicillin-Resistant

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► Implication for health policy/practice/research/medical education:

Atopic dermatitis is currently considered as a common disease and colonization with *Staphylococcus aureus* is prevalent in these patients. The rate of colonization correlates with the severity of eczema (SCORAD). We do suggest that patients with severe scorad are colonized with methicillin resistant *Staphylococcus aureus*. This may assist practitioners in order to manage infections.

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## 1. Background

Atopic dermatitis (AD) is a common complex disease that frequently follows a chronic relapsing course and significantly affects the quality of life of the patients and families (1). Patients with AD exhibit defects in innate and acquired immune response resulting in a heightened susceptibility to bacterial, fungal and viral infections, most notably colonization by *Staphylococcus aureus* (*S.aureus*) (2).

*S.aureus* worsens AD by secreting superantigens and structural molecules within the cell wall that induce skin inflammation (3). Studies revealed the severity of atopic dermatitis [Scoring of Atopic Dermatitis (SCORAD)] correlated with colonization by *S.aureus* and the density of bacteria (4, 5). It has been found that antibiotic resistance was one of the factors in *S.aureus* recolonization (6).

## 2. Objectives

On the basis of these studies, we designed this study in order to identify correlation between SCORAD in AD and methicillin resistance pattern in *S.aureus*.

## 3. Materials and Methods

In a cross-sectional study, we studied 38 patients with AD (diagnosed based on Hanifin and Rajka criteria) (7), who had been referred to the allergy clinic in Mofid children's hospital in Tehran, Iran, with simple nonrandomized consecutive sampling.

A questionnaire was filled out for every patient and the severity of diseases was graded with the SCORAD system (8). The SCORAD was classified into three groups (mild = lower than 25, moderate ranged from = 25-50, severe = higher than 50). Informed consent was signed by the patients. Then three samples for *S.aureus* detection were taken from the nasal cavity, healthy and AD lesions and the specimens were inoculated in salt agar manitol milieu (Merck, Lot: VM 136304 016). Following 24 hours of incubation, suspected colonies were studied for Coagulase (Rabbit Plasma With EDTA, IRAN, Lot: 9012), DNAase (Merck, Lot: VM 324249 364) and Ureas enzymes (Merck, Lot, VM 938192 515). Subsequently, isolated *S.aureus* was examined with E test (AB, BIODISK) for methicillin resistance pattern and MSSA and MRSA subtypes were characterized.

The data was analyzed by SPSS (11.5 version) and Logistic regression analysis was used to study the coexistence between methicillin resistance pattern and the SCORAD index.

## 4. Results

### 4.1. Patients' Characteristics

The patients' age ranged from 2 to 108 months. Twelve patients had mild SCORAD, 18 patients had moderate and 8 had severe SCORAD. Other Characteristics are summarized in Table 1.

**Table 1.** Demographic and Clinical Characteristics of Patients With Atopic Dermatitis

Characteristics	Patients (38)
Age (mo), mean (range)	19 (2-108)
Male gender, No. (%)	28 (73.3)
Age at presentation (mo) (range)	5 (1-24)
Family history of atopy (%)	27 (72%)
Mean objective SCORAD, mean (range)	37.8 (15-80)

### 4.2. *S.aureus* and MRSA Colonization

Altogether, 18 patients (47%) were colonized by *S.aureus* in different sites of sampling. The number and percentage of colonized patients in different sampling sites and the ratio of MRSA colonization in different sites is summarized in Table 2. Among all the cultures (114 samples), MSSA (Methicillin Sensitive *Staphylococcus aureus*) was noted in 26 (22%) and MRSA was noted in 13 (11%). Of positive *S.aureus* cultures, MRSA accounted for 33% of all *S.aureus* isolates.

**Table 2.** *S.aureus* and MRSA Colonization Rates in Different Sites of Sampling in Patients With Dermatitis Atopic

Site of Sampling	No. and Percentage of <i>S.aureus</i> Colonized Patients, No. (%)	Ratio of MRSA Colonization among <i>S.aureus</i> Colonized Patients, Ratio (%)
Healthy skin	8 (21)	4/8 (50)
Nasal cavity	17 (44)	4/17 (23)
AD lesions	14 (36)	5/14 (35)

The percentage of *S.aureus* colonization in different sites of sampling in patients with mild, moderate and severe AD is shown in Table 3. There was a significant relationship ( $P = 0.001$ ) between AD severity and *S.aureus* colonization in nasal cavity and AD lesions.

**Table 3.** The Percentage of *S.aureus* Colonization in Different Sites of Sampling in Patients With Mild, Moderate and Severe AD

	Normal Skin	AD Lesions	Nose
Mild AD	8.3	16.6	16.6
Moderate AD	22.2	38.9	50
Severe AD	37.5	62.5	75
P. Value	> 0.05	0.001	0.001

Abbreviations: AD, Atopic Dermatitis; *S.aureus*, *Staphylococcus aureus*

The rate of *S.aureus*, MRSA and MSSA colonization in patients with mild, moderate and severe AD has been compared in Table 4. We found MRSA only in AD patients with moderate SCORAD (in 5 patients).

**Table 4.** The Rate of *S.aureus*, MRSA and MSSA Colonization in Patients With Mild, Moderate and Severe AD.

	Mild (12)	Moderate (18)	Severe (8)
<i>S.aureus</i>	2 (16.7%)	10 (55.6%)	6 (75.0%)
MRSA	0 (0.0%)	5 (27.8%)	0 (0.0%)
MSSA	2 (16.7%)	5 (27.8%)	6 (75.0%)

Abbreviations: *S.aureus*, *Staphylococcus aureus*; MRSA, methicillin resistant *Staphylococcus aureus*; MSSA, methicillin sensitive *Staphylococcus aureus*

## 5. Discussion

Patients with atopic dermatitis are prone to *S.aureus* colonization and infection. Recent studies showed the high rate of *S.aureus* colonization in these patients, especially in AD skin lesions and the nasal cavity, which ranged between 76–100%, compared to 2–25% in healthy subjects (9-11). This is likely the result of a combination of host factors including skin barrier dysfunction as well as impaired host immune responses in AD (12, 13). Comparing the above-mentioned studies, we found lower rate of overall *S.aureus* colonization in our patients (47%). Lo et al. (14) in Taiwan found that *S.aureus* colonization rates were 50% in their patients which is similar to our results.

Our study showed a higher rate of *S.aureus* colonization in the nasal cavity and AD lesions compared to healthy skin (44%, 36%, and 21%, respectively). Nasal carriage of *S.aureus* in the general population is approximately 10–45% and is higher among patients with AD (39–100%) (15, 16). In our study, among positive cultures, MRSA accounted for 33% of all *S.aureus* isolates. Recent trends indicate an increasing incidence of CA-MRSA (community-associated MRSA) in the general population (17), and some studies have showed the high rate of MRSA in AD (14, 18, 19). A study by Lo et al. have shown that 60% of *S.aureus* isolates from 20 children with AD and skin and soft-tissue infections were classified as MRSA but the percentage of MRSA isolates among all *S.aureus*-colonizing isolates was 28.3% (14).

Ortega-Loayza et al. analyzed 141 cultures from 93 pediatric dermatology patients in North Carolina, where 66% of the cultures that had been taken from children with atopic dermatitis. *S.aureus* was recovered from 97 cultures of which 32% were MRSA (19). Schlievert et al. have recently tested a small group of AD isolates for methicillin resistance *S.aureus* and have found that 25% were MRSA (18). Chung et al. in a South Korean clinic noted a 75.4% incidence rate of *S.aureus* colonization in children with atopic dermatitis, with 18.3% incidence of CA-MRSA in skin lesions (20).

Some studies have shown lower colonization rate for MRSA. In a study done by Huang et al. on 31 patients with

AD, 7.4% of AD skin lesions and 4% of the nares with positive cultures for *S.aureus* were resistant to methicillin (21).

Our results revealed significant correlation between SCORAD score and colonization with *S.aureus* in AD skin lesions and the nasal cavity ( $P = 0.001$ ). Some other studies have found that the severity of dermatitis correlates with the density of *S.aureus* colonization on AD skin lesions and anti *S.aureus* antibiotics have been shown to mitigate the severity of AD (22, 23). Kedzierska et al. in 87 AD patients showed a positive correlation between the colonization density of *S.aureus* in AD skin lesions and the severity of AD, and they reported no significant correlation between density of bacteria in healthy skin and SCORAD (24). Hon et al. also found that the anterior nares are an important site for *S.aureus* and that nasal colonization was associated with more extensive lesions and a higher SCORAD index (25). The authors in one study have suggested that the production of inflammatory cytolytins and high-level superantigens by CA-MRSA increases their ability to cause extensive AD infections (18).

Tomi et al. and Zoller et al. have shown that the increased AD severity correlates with the presence of a super antigen produced by *S aureus* (25-27). However, our study could not conclude a relationship between type of *S.aureus* (MSSA or MRSA) and SCORAD index since we found MRSA just in moderate SCORAD and none of the isolated *S.aureus* in severe and mild groups were MRSA. One study designed by Chiu et al. to determine the distribution of the bacterial virulence factors (such as; toxic shock syndrome toxin, staphylococcal enterotoxins A-E, G-K, enterotoxin gene cluster egc, exfoliatin A, B, and D) and their correlation with disease severity in 34 patients with AD, have shown that patients with a moderate SCORAD were more likely to be colonized by enterotoxin B-positive *S.aureus* ( $P = 0.027$ ) and no virulence factor was significantly associated with a severe SCORAD (16). We are not sure exactly the reason of the lack of MRSA in patients with severe SCORAD, but certain reasons can be suggested. There were only a few patients with MRSA and the number of patients was not similar in each level of severity. We did not match for age in different groups of severity. One retrospective study in children with atopic dermatitis has shown that the prevalence of MRSA is increased in children older than 5 years (28). Other research without these limitations may help to clarify the significance of this abnormal finding.

In conclusion, our data shows lower rate of *S.aureus* colonization in AD patients but a similar rate of MRSA colonization in comparison with former studies. In our study the patients with moderate SCORAD had a higher rate of MRSA colonization. We did not have a control group in our study and also do not know about *S.aureus* colonization rate in our general population. More research with a control group and larger sample sizes would be supportive for identification of the exact relationship between

MR pattern and SCORAD index in atopic dermatitis.

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## Authors' Contribution

None declared.

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