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Brief report

# Prevalence of nasal carriage of methicillin-resistant *Staphylococcus aureus* in children with diabetes mellitus: Trends between 2005 and 2013

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The aim of this prospective study was to establish the methicillin-resistant *Staphylococcus aureus* (MRSA) colonization rates in pediatric outpatients with type 1 diabetes mellitus, while also evaluating changes in colonization rates over time. There was no significant difference between 2005 and 2013 patients in terms of demographic and clinical findings. MRSA colonization rates were 0.7% (in 101 patients) and 0.9% (in 134 patients) ($P = .84$). Although increased MRSA colonization has become a significant problem worldwide, it does not seem to be a major issue in our diabetic outpatient population.



*Staphylococcus aureus* is an important cause of skin and soft tissue infections and invasive infections, such as pneumonia, osteomyelitis, and bacteremia. Methicillin-resistant *S aureus* (MRSA) is a worldwide major health issue that has an impact on health care and the community as a whole. The anterior nares are the primary ecological reservoir of *S aureus*. Although most individuals with nasal carriage are asymptomatic, clinically significant staphylococcal disease is known to develop.[1] Prolonged length of hospital stay, recent history of hospitalization, regular nursing home contact (eg, nursing home residents), history of exposure to health care–associated pathogens, diabetes mellitus (DM), and burns are established risk factors for nasal MRSA colonization.[1-4]

Data on the epidemiology of MRSA in healthy Turkish individuals are limited, and available studies report on a low prevalence between 0.1% and 0.3%.[5,6] Nasal colonization rates in children and adolescents with type 1 DM have been evaluated in only 1 study,[3] in contrast with the few adult studies that may be encountered in the English literature.[4,7] To our knowledge there is no published study in which trends in the prevalence of nasal colonization have been explored on outpatients with type 1 DM. We hypothesized that MRSA colonization in children with type 1 DM differs from their adult counterparts, particularly with respect to clinical features and changes over time. The objective of this study was to determine the MRSA colonization rates in our pediatric type 1 diabetic outpatient population, clinical characteristics associated with colonization, and any apparent changes between 2005 and 2013.

## MATERIALS AND METHODS

### *Study design*

This prospective study was conducted in the outpatient clinic of the Department of Pediatric Endocrinology and Metabolism at Hacettepe University with the approval of the local ethics committee in accordance with the Declaration of Helsinki.

Children with a known diagnosis of type 1 DM who presented within the predetermined study periods between January-April 2005 and January-April 2013 were approached for inclusion in the study. None of the patients in 2013 were previously sampled in 2005. The International Society for Pediatric and Adolescent Diabetes criteria were used to diagnose type 1 DM.[8] All children were receiving subcutaneous insulin therapy. After written parental (legal guardian) and child consent (>7 years of age), patients were

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screened for eligibility. Information regarding patient age, sex, duration of DM diagnosis, recent glycated hemoglobin levels, concomitant disease, recent antibiotic use (within the previous 3 months), flu vaccination status, recent hospitalization (within the previous year), presence of a health care worker or smoker at home, and daycare or school attendance was recorded for each participant.

*Nasal sampling and microbiologic evaluation*

Bilateral anterior nares cultures were obtained for each patient using rayon swabs which were placed in Stuart Transport Medium (BD, Franklin Lakes, NJ) for transport. Obtained specimens were inoculated onto CHROMagar MRSA medium (CHROMagar Microbiology, Salubris, Turkey), followed by incubation for 24 hours at 35°C. All yellow-colored colonies grown on mannitol-salt agar plates and all colonies grown on chromogenic agar underwent gram staining, catalase test, DNase, and coagulase test.

The cefoxitin disk diffusion test was applied to all pink-red colonies grown on chromogenic agar to determine methicillin resistance, as recommended by the Clinical and Laboratory Standards Institute. This method entails transfer of a colony into a Mueller-Hinton Agar for *S aureus*, which is kept at room temperature for 5-10 minutes before placement of a cefoxitin disk (30 μg; Oxoid, Basingstoke, Hampshire, UK) to the surface of the medium. Zones of inhibition are evaluated after incubation for 18-24 hours at 35°C. According to the Clinical and Laboratory Standards Institute criteria, an inhibition zone of ≤21 mm is indicative of methicillin resistance compared with an inhibition zone of ≥22 mm, which indicates methicillin sensitivity.

*Statistical analysis*

Statistical analyses were performed using SPSS for Windows version 17.0 (SPSS Inc, Chicago, IL). Demographic and clinical features and MRSA colonization rates were compared between patients from 2005 and 2013. Continuous variables were compared using the independent samples *t* test, and categorical variables were compared using $\chi^2$ or Fisher exact test for association. A *P* value of <5% was considered indicative of statistical significance.

## RESULTS

Nasal cultures were obtained from 101 patients (54.4% boys; mean age, 12.03 ± 3.48 years) during the 4-month study period in 2005 and from 134 patients (50.7% boys; mean age, 12.23 ± 3.88) during the corresponding period in 2013. Children and adolescents aged between 2 and 18 years diagnosed with type 1 DM with disease duration of at least 2 months were selected to take part. In the overall diabetic population, 20 cases (8.5%) were found to have microalbuminuria. The most common concomitant diseases were Hashimoto thyroiditis (8.5%), celiac disease (6.3%), obesity (2.9%), precocious puberty (1.7%), and asthma (1.7%).

Comparison of patients from 2 time frames did not reveal a significant difference in terms of age, sex distribution, duration of DM diagnosis, recent glycated hemoglobin levels, concomitant disease, daycare or school attendance, use of antibiotics in the previous 3 months, flu vaccination status, and presence of health worker or smoker at home. Hospitalization rate within the previous year was significantly lower in the 2013 group than the 2005 group (45.5% vs 12.6%, $P < .05$). Most frequently used antibiotics within 3 months prior to enrollment during both time periods were amoxicillin and clavulanic acid (57.7%), macrolides (21.1%), amoxicillin (16.6%), and second-generation cephalosporins (4.4%). Respective MRSA colonization rates in 2005 and 2013 were 0.9% and 0.7% ($P > .05$). Demographic and clinical characteristics of the study participants are summarized in Table 1.

**Table 1**
Demographic and clinical characteristics of participants with DM from January-April 2005 and January-April 2013 periods

| Parameter | January-April 2005 (n = 101) | January-April 2013 (n = 134) | *P* value |
|---|---|---|---|
| Age (y) | 12 ± 3.4 | 12.2 ± 3.8 | .67 |
| Male sex, n (%) | 55 (54.4) | 68 (50.7) | .33 |
| Duration of DM diagnosis (mo) | 56.8 ± 36.4 | 63.6 ± 39.8 | .18 |
| Recent HbA1c levels (%) | 8.30 ± 1.27 | 7.78 ± 1.12 | .15 |
| Concomitant disease | 25 (24.7) | 45 (33.5) | .09 |
| Daycare or school attendance | 81 (80.1) | 123 (91.7) | .35 |
| Recent antibiotic use | 35 (34.6) | 55 (41) | .22 |
| Flu vaccination status | 47 (46.5) | 55 (41) | .35 |
| Health worker at home | 13 (12.7) | 14 (10.4) | .33 |
| Smoker at home | 61 (60.3) | 81 (60.4) | .98 |
| Hospitalization within previous year | 46 (45.5) | 17 (12.6) | .001 |
| MRSA colonization | 1 (0.9) | 1 (0.7) | .84 |

NOTE. Values are mean ± SD, %, or as otherwise indicated.
*DM*, diabetes mellitus; *HbA1c*, glycated hemoglobin; *MRSA*, methicillin-resistant *Staphylococcus aureus*.

## DISCUSSION

Several studies report on a rapid increase in recent years in *S aureus* infections among both children and adults, mainly attributable to an increase in MRSA. The prevalence of MRSA colonization among children has been extensively studied in several community-based studies from different countries,[5-7,9,10] with significant differences between studies in terms of colonization rates. Reported prevalence rates ranged from 1%-2.3% in North and South America, to 7.6% in Asia.[11] Little is known about the epidemiology of MRSA in Turkey, with an established carrier rate of 0.1% in an outpatient pediatric population[6] and 0.3% in healthy preschoolers.[5]

Nasal colonization rates of MRSA are affected by the presence of an underlying medical condition or a chronic disease. Children with chronic conditions have frequent contact with health care centers, therefore increasing their exposure to health care–associated microorganisms. In a study by Gesualdo et al,[11] children with an underlying medical condition had an MRSA colonization prevalence of 5.2% compared with 2.3% in healthy children. Despite the relatively fewer number of studies on children with DM, reported MRSA colonization rates are significantly lower in comparison with studies on adult populations.[3,4] This could be attributed to the shorter follow-up periods in children after a diagnosis is confirmed and to a lower prevalence of complications, such as chronic renal failure and diabetic foot, which are known to increase the risk of MRSA colonization.

Our study is not without its limitations. This study was designed as a cross-sectional study where patients were evaluated during 2 separate years involving a different set of patients. Instead, serial sampling of the same patients in 2005 and 2013 would have provided a clearer picture regarding the change in nasal MRSA colonization rates over the years. Another limitation is that we were not able to do a multivariable analysis because of low MRSA colonization rates. Hence, confounding or interactions between variables cannot be assessed. Furthermore, our study was based on data from a single center, and the ensuing results cannot therefore be considered representative of the general Turkish population.

The MRSA colonization rates observed in this study on children with DM presenting as outpatients were lower than expected, even comparable with rates seen in the general population. No significant change in rates was observed between 2005 and 2013 (0.9%