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RESEARCH

Secondary skin infections following scabies in children: clinical findings and risk factors

Çocuklarda uyuz sonrası ikincil cilt enfeksiyonları: klinik bulguları ve risk faktörleri

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Abstract

Purpose: This study aimed to identify the clinical and behavioral risk factors associated with secondary bacterial skin infections in children with scabies.

Materials and Methods: We retrospectively reviewed records of 200 children (0–18 years) diagnosed with scabies between January 2022 and December 2024. All received a two-dose permethrin regimen and were followed for 30 days. Collected data included age, sex, pruritus severity, symptom-to-diagnosis interval, treatment adherence, and household contact treatment..

Results: Secondary skin infection occurred in 35% of children at a median of 9 days (Interquartile range (IQR) 6–12) after treatment. The median interval from symptom onset to scabies diagnosis was 11 days (IQR 8–15). In bivariate analyses, infected children were younger (median age 7.5 vs. 8.5 years) and had higher pruritus scores (7.0 vs. 5.0). Multivariable analysis identified five independent predictors. Younger age (adjusted odds ratio (aOR) 0.92 per year; 95% confidence interval (CI) 0.85–0.99), higher pruritus score (aOR 1.18 per point; 95% CI 1.06–1.31), longer symptom-to-diagnosis interval (aOR 1.10 per day; 95% CI 1.02–1.19), incomplete topical application (aOR 2.9; 95% CI 1.3–6.4) and failure to treat household contacts (aOR 3.7; 95% CI 1.6–8.5). Impetigo (48.5%) and cellulitis (24.6%) were the most frequent manifestations.

Conclusion: Early diagnosis, complete topical application, household treatment, and monitoring pruritus severity are key to reducing secondary infections in pediatric scabies.

Keywords:. Scabies; skin diseases, infectious; pediatrics; risk factors; treatment adherence and compliance

Öz

Amaç. Bu çalışma, uyuz tanısı alan çocuklarda ikincil bakteriyel cilt enfeksiyonlarıyla ilişkili klinik ve davranışsal risk faktörlerini belirlemeyi amaçlamıştır.

Gereç ve Yöntem: Ocak 2022–Aralık 2024 tarihleri arasında uyuz tanısı alan 0–18 yaş arası 200 çocuk geriye dönük olarak incelendi. Tüm hastalara iki dozluk permetrin tedavisi uygulandı ve tedavi başlangıcından itibaren 30 gün boyunca izlendi. Toplanan veriler arasında yaş, cinsiyet, kaşıntı şiddeti, semptomların başlamasından tanıya kadar geçen süre, tedaviye uyum ve ev içi temaslıların tedavi edilip edilmediği yer aldı.

Bulgular: İkincil cilt enfeksiyonu çocukların %35'inde, tedavi sonrası medyan 9 günde (çeyrekler arası aralık (IQR) 6–12) ortaya çıktı. Semptom başlangıcından uyuz tanısına kadar geçen medyan süre 11 gündü (IQR 8–15). İkili analizlerde enfekte çocuklar daha küçük yaştaydı (medyan 7,5 vs. 8,5 yıl) ve kaşıntı skorları daha yüksekti (7,0 vs. 5,0). Çok değişkenli analizde beş bağımsız öngörücü saptandı. Daha küçük yaş (her yıl için düzeltilmiş olasılık oranı (aOR) 0,92; %95 güven aralığı (GA) 0,85–0,99), daha yüksek kaşıntı puanı (her puan için aOR 1,18; %95 GA 1,06–1,31), semptomdan tanıya kadar geçen sürenin uzunluğu (her gün için aOR 1,10; %95 GA 1,02–1,19), eksik topikal uygulama (aOR 2,9; %95 GA 1,3–6,4) ve ev içi temaslıların tedavi edilmemesi (aOR 3,7; %95 GA 1,6–8,5). En sık görülen bulgular impetig (%48,5) ve selülit(%24,6) idi.

Sonuç: Pediatrik uyuz olgularında ikincil enfeksiyonların önlenmesinde erken tanı konulması, topikal tedavinin eksiksiz ve doğru uygulanması, ev içi temaslıların eş zamanlı tedavi edilmesi ve kaşıntı şiddetinin düzenli olarak izlenmesi büyük önem taşımaktadır.

Anahtar kelimeler: Uyuz; cilt hastalıkları, enfeksiyon; pediatri; risk faktörleri; tedaviye uyum ve bağlılık.

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INTRODUCTION

Scabies is a highly contagious parasitic skin disease caused by *Sarcoptes scabiei*. Globally, nearly 200 million people are affected, with prevalence rates ranging from 0.2% to 71% in endemic regions[1]. Children are particularly vulnerable, with infection rates reaching 5–10% in most populations, and exceeding 50% in some low-resource tropical settings[1,2]. In recognition of its global burden, the World Health Organization (WHO) classified scabies as a Neglected Tropical Disease in 2017[3].

In recent years, scabies has resurged in many countries, including Türkiye. Following the COVID-19 pandemic, cases sharply increased. In Adana, prevalence rose from 4.2% in 2018 to over 20% by 2024[4]. Pediatric cases are especially common and frequently misdiagnosed[5]. A 2024 study found that 18.5% of children initially treated for eczema were later confirmed to have scabies[6]. These patterns highlight both rising incidence and diagnostic challenges, particularly in children.

One of the most important—but underrecognized—complications of pediatric scabies is secondary bacterial skin infection. Scabies causes intense pruritus, and scratching disrupts the skin barrier, allowing bacterial entry[7]. Secondary infections such as impetigo, cellulitis, paronychia, and abscesses are frequently reported, particularly those caused by *Staphylococcus aureus* and *Streptococcus pyogenes*[7]. These infections may lead to serious outcomes, including glomerulonephritis or rheumatic fever[4,8].

Several risk factors have been proposed, including diagnostic delay, misdiagnosis, incomplete treatment, and untreated household contacts[2,6,9]. However, most prior studies were descriptive or lacked multivariable analysis to quantify the contribution of each factor. To our knowledge, no large-scale cohort study in Türkiye has systematically evaluated these predictors in children using a standardized treatment protocol.

Therefore, this study aimed to determine the incidence and independent predictors of secondary bacterial skin infections in pediatric scabies. Specific objectives included evaluating the role of age, pruritus severity, diagnostic delay, adherence to permethrin therapy, and household contact management.

We hypothesized that delayed diagnosis, incomplete treatment application, and untreated household members would significantly increase the risk of secondary infection. By identifying and quantifying these modifiable factors, our study seeks to inform both clinicians and public health planners about actionable strategies to reduce preventable morbidity in affected children.

MATERIALS AND METHODS

Setting and design

This study was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee of Cukurova University Faculty of Medicine (Approval No: 152; Date: 07 February 2025). As the study was retrospective in design, formal written consent was not required at the time of data collection. However, due to the relapsing nature of scabies and the structured follow-up protocol used in this study, the majority of patients returned for control visits. During these follow-up visits, verbal and written informed consent for use of anonymized clinical data was obtained from parents or legal guardians. All data were anonymized prior to analysis to ensure confidentiality.

This retrospective cohort study was conducted at the General Pediatric Outpatient Clinic of Çukurova University Faculty of Medicine, a tertiary academic medical center in Adana, Türkiye. The hospital uses a structured electronic medical record (EMR) system, ensuring high reliability and completeness of clinical data. All patient assessments, diagnoses, and treatments were performed by three associate professors specializing in pediatric infectious diseases, general pediatrics, and dermatology—each with over 10 years of clinical experience.

Sample

Between January 2022 and December 2024, approximately 35,000 pediatric patients were evaluated in the general pediatric outpatient clinic. Among these, 500 children were clinically diagnosed with scabies. Inclusion criteria were: children under 18 years of age, with a clinical diagnosis of scabies confirmed by a dermatologist, and completion of the standardized follow-up protocol.

Exclusion criteria included systemic immunodeficiency, coexisting chronic dermatoses or systemic diseases predisposing to skin infections, and missing or incomplete medical records. Based on these criteria, 200 patients were included in the final

analysis, and 300 were excluded (n=110 incomplete records, n=115 comorbidities, n=75 immunodeficiency).

A post hoc power analysis was conducted to evaluate whether the final sample size (n = 200) was sufficient to detect clinically meaningful differences. Secondary skin infection occurred in 9.2% of children with complete treatment adherence, and in 24.3% of those with incomplete application. Based on this effect size and a significance level of $\alpha = 0.05$, the study achieved a power of 88%. With 70 infection events and five predictors included in the logistic regression model, the events-per-variable (EPV) ratio was 14, exceeding the minimum threshold of 10. A simulation assuming an AUC of 0.75 yielded an estimated power of 81%, confirming the model's adequacy.

Standardized follow-up protocol

All patients were followed using a structured monitoring schedule:

- Day 0 (Baseline): First dose of 5% permethrin overnight; application instructions; same-day household treatment; environmental decontamination advice; pruritus-VAS recorded.
- Day 7 (±2): Supervised second-dose application; adherence checklist; adverse-event reporting.
- Day 14 (±3): Focused examination to differentiate post-scabetic itch from active lesions.
- Day 30 (±5): Full dermatological reassessment; VAS score repeated.
- Unscheduled visits: Triggered by infection signs (e.g., fever, spreading erythema, pustules); lesion culture, leukocyte count, CRP, and empirical antibiotics administered as needed.

Data collection and definitions

Demographic and clinical variables were extracted from electronic records using a standardized abstraction form. These included age, sex, lesion distribution, pruritus severity, time from symptom onset to diagnosis, adherence to the two-dose permethrin regimen, household contact treatment, and family history of scabies. Pruritus severity was assessed using the Visual Analog Scale (VAS), a 0–10 scale where 0 indicates no itching and 10 indicates the most severe imaginable itching. VAS scoring was performed by a trained pediatric resident at each visit, based on structured parental interviews and physical observations.

Secondary bacterial skin infection was defined by clinical signs (impetigo, cellulitis, paronychia, or abscess) plus at least one of the following laboratory findings: leukocyte count $>10\times10^9$/L, c-reactive Protein (CRP) ≥10 mg/L, erythrocyte sedimentation rate (ESR) ≥20 mm/h, positive direct smear (≥10 polymorphonuclear leukocytes (PMNs) + bacteria) or radiologic evidence of abscess.

Statistical analysis

Continuous variables were assessed for normality using the Shapiro–Wilk test. As most variables were not normally distributed, medians and interquartile ranges (IQR) were reported, and group comparisons were performed using the Mann–Whitney U test. Categorical variables were expressed as counts and percentages, and compared using Pearson's chi-square test or Fisher's exact test where appropriate.

Variables with a p-value <0.10 in univariate analysis, along with age and sex, were entered into a multivariable logistic regression model (enter method) to determine independent predictors of secondary infection. Adjusted odds ratios (aOR) and 95% confidence intervals (CI) were reported. Multicollinearity was evaluated prior to model inclusion.

The model's calibration was assessed via the Hosmer–Lemeshow goodness-of-fit test, and discriminative performance was evaluated using the area under the receiver operating characteristic (ROC) curve. A p-value <0.05 was considered statistically significant. Statistical analysis was conducted using Statistical Package for the Social Sciences (SPSS) v25.0 (IBM Corp., Armonk, NY).

RESULTS

A total of 200 children met the inclusion criteria; 70 (35%) developed a clinically confirmed secondary skin infection, whereas 130 (65%) remained infection-free. Children who developed secondary skin infection had a significantly longer median interval from symptom onset to scabies diagnosis (11 vs 9 days; p = 0.005). Baseline demographic and clinical characteristics were compared in Table 1.

Table 1. Baseline characteristics of children with and without secondary skin infection

Variable	Secondary infection (n = 70)	No infection (n = 130)	p-value
Age, years – median (IQR)	7.5 (6.0–10.0)	8.5 (7.0–11.0)	0.032 †
Pruritus VAS (0–10) – median (IQR)	7.0 (6.5–8.0)	5.0 (4.0–6.0)	0.002 †
Interval from symptom onset to scabies diagnosis, days – median (IQR)	11 (8–15)	9 (6-12)	0,005†
Pigmentation change, n (%)	15 (21.4)	0 (0)	0.0003 §
Scar formation, n (%)	12 (17.1)	0 (0)	0.0008 §
Family history of scabies, n (%)	30 (42.8)	24 (18.5)	0.045 ‡
Recurrent scabies episodes, n (%)	18 (25.7)	10 (7.8)	0.003 ‡
Household treated simultaneously, n (%)	32 (45.7)	95 (73.1)	0.008 ‡
Environmental measures taken, n (%)	27 (38.6)	81 (62.3)	0.011 ‡
Incomplete topical application, n (%)	17 (24.3)	12 (9.2)	0.004 ‡

IQR: Interquartile range; VAS: Visual Analog Scale† Mann–Whitney U test (for non-normally distributed continuous variables);‡ Pearson's Chi-square test;§ Fisher's exact test (due to zero cell count in one group)

Although 10 variables met the univariate threshold of $p < 0.10$ (age, pruritus VAS, delay from symptom onset to diagnosis, pigmentation change, scar formation, family history of scabies, recurrent scabies episodes, household treated simultaneously, environmental measures taken and incomplete topical application), only five were retained in the multivariable model. Although both scar formation and pruritus VAS were initially considered, collinearity diagnostics revealed a high degree of correlation (VIF > 5), suggesting that scar formation may be a downstream consequence of intense pruritus. Therefore, to avoid redundancy and preserve model stability, scar formation was excluded from the multivariable analysis. The remaining univariate predictors pigmentation change, family history, recurrent episodes and environmental measures failed to reach $p < 0.05$ when forced into the logistic regression. As a result, only age, pruritus VAS, incomplete topical application, delay from symptom onset to diagnosis and failure to treat household contacts appear in Table 2. Multivariable logistic regression analysis showed that five factors independently influenced the risk of secondary skin infection in children. Each additional year of age was associated with an 8% reduction in odds (aOR 0.92; 95% CI 0.85–0.99, p=0.028), whereas each one-point increase in pruritus VAS score raised the odds by 18% (aOR 1.18; 95% CI 1.06–1.31, p=0.003). Every extra day from symptom onset to scabies diagnosis increased the odds by 10% (aOR 1.10; 95% CI 1.02–1.19, $p = 0.014$). Incomplete topical permethrin application nearly tripled the risk (aOR 2.9; 95% CI 1.3–6.4, p=0.008) and failure to treat household contacts increased the odds by 3.7-fold (aOR 3.7; 95% CI 1.6–8.5, $p = 0.003$). (see Table 2). Model calibration was confirmed by a non-significant Hosmer–Lemeshow test ($\chi^2 = 6.28$, $p = 0.62$), indicating close agreement between predicted and observed infection rates across risk deciles. Discriminative performance was acceptable, as evidenced by an area under the ROC curve of 0.77, demonstrating that the model reliably distinguishes between children who did and did not develop secondary skin infections.

Among the 70 children who developed a secondary skin infection, impetigo was the most common (34/70, 48.5%), followed by cellulitis (17/70, 24.6%), paronychia (11/70, 15.7%) and abscesses (8/70,

11.2%). In the cohort of 70 children who developed secondary skin infections following scabies therapy, 22 (31%) presented within 7 days (early), 38 (54%) between days 7 and 14 (intermediate) and 10 (15%) after day 14 (late). The median time to secondary skin infection was 9 days (IQR 6–12). A χ^2 goodness-of-fit test comparing observed case counts across these three intervals to an equal distribution yielded χ^2 = 16.9 (df = 2, p = 0.0002), indicating a highly significant clustering of secondary infections within the first two weeks post-treatment.

Table 2. Multivariable logistic regression for predictors of secondary skin infection

Predictor	Adjusted OR (95% CI)	p-value
Age (per year increase)	0.92 (0.85–0.99)	0.028
Pruritus VAS (per 1-point increase)	1.18 (1.06–1.31)	0.003
Delay from symptom onset to diagnosis (per day)	1.10 (1.02–1.19)	0.014
Incomplete topical application	2.9 (1.3–6.4)	0.008
Failure to treat household contacts	3.7 (1.6–8.5)	0.003

OR: Odds Ratio; CI: Confidence Interval; VAS: Visual Analog Scale

DISCUSSION

Among 200 children with scabies, 35% developed secondary bacterial skin infections within 30 days. The most common complications were impetigo (48.5%), cellulitis (24.6%), paronychia (15.7%), and abscesses (11.2%). Five independent predictors emerged: younger age, higher pruritus VAS score, longer diagnostic delay, incomplete permethrin application, and failure to treat household contacts. While younger age and higher pruritus intensity are non-modifiable—likely reflecting thin skin and frequent scratching in younger children—the remaining three are directly modifiable and represent intervention points for clinicians and public health systems. Permethrin 5% is the first-line topical therapy for scabies worldwide, recommended by both the World Health Organization and national guidelines due to its high efficacy, low toxicity, and suitability for infants over two months of age[17]. It acts by disrupting sodium channels in mite neurons, causing paralysis and death. Its use as the cornerstone of therapy in this study reflects these global recommendations, and adherence to a two-dose regimen significantly reduced the incidence of secondary infections. Improper use or incomplete application tripled the infection risk, reinforcing earlier data linking non-compliance with both treatment failure and complications[18].

More than 80% of infections clustered in the first two weeks post-treatment (median 9 days), suggesting a narrow but critical window for infection surveillance and intervention. This early clustering supports the integration of routine follow-up evaluations at 7–10 days, a strategy that can identify children at risk of worsening lesions or superinfection requiring prompt antibiotic therapy.

The 35% secondary infection rate aligns with data from Fiji and Ethiopia (30–38%) and falls between previous reports from Türkiye (7–8%) and hyperendemic Pacific communities (50–70%)[10–14]. This variation may result from differences in diagnostic methods, follow-up intensity, or contextual factors such as hygiene and overcrowding. Our higher rate may be attributed to standardized follow-up, broader inclusion criteria for infection, and better detection due to structured assessments.

Delay in diagnosis and high pruritus severity were significant predictors of infection. Mechanistic studies have shown that scratching damages the stratum corneum and that *Sarcoptes scabiei* secretes protease inhibitors that suppress antimicrobial peptides, reducing skin immunity[7]. WHO guidance similarly notes that scratching during the asymptomatic latency phase (2–6 weeks) predisposes to impetigo and deeper infections in young children[17]. Our findings reinforce these biological pathways: each extra day to diagnosis increased the odds of infection by 10%, and each one-point rise in pruritus VAS increased the risk by 18%.

The distribution of bacterial complications in our study mirrors global trends, with *Staphylococcus aureus* and *Streptococcus pyogenes* as the most common

pathogens[10-12]. While cellulitis and abscesses were less frequent than impetigo, they represent more severe outcomes and are associated with greater morbidity. The notable incidence of paronychia (15.7%) suggests that periungual trauma from scratching may be under-recognized in clinical practice and deserves closer attention.

Household contact management was another key modifiable factor; failure to treat cohabitants increased infection risk 3.7-fold. As scabies is easily transmitted within households, treating all close contacts simultaneously is essential to prevent reinfestation and continuous skin barrier disruption. Our protocol's emphasis on household decontamination and direct observation of the second permethrin dose likely improved outcomes and could serve as a model for clinical practice.

Despite the strengths of our study including its relatively large pediatric cohort, standardized follow-up, and multivariable analysis several limitations must be acknowledged. The retrospective single-center design may limit generalizability. The 30-day observation period may have missed late-onset infections, and unmeasured confounders such as hygiene behaviors or nutritional status could have affected results. Additionally, our findings may not be fully generalizable to rural or resource-limited populations.

In summary, secondary bacterial skin infections complicated over one-third of pediatric scabies cases in this cohort. Younger age, intense pruritus, diagnostic delay, incomplete treatment, and lack of household contact therapy were key risk factors three of which are modifiable. These findings underscore the importance of early diagnosis, structured treatment adherence, simultaneous household therapy, and pruritus control.

Future studies should aim to develop predictive risk models incorporating the identified factors, evaluate the real-world effectiveness of structured follow-up protocols, and explore community-based interventions such as school-based screening and mass treatment strategies. Additionally, long-term outcomes and recurrence risks should be investigated to better understand the full burden of scabies-related complications. Implementing comprehensive post-treatment care pathways centered on early detection, patient and caregiver education, and strict adherence to standardized scabies treatment protocols has the potential to significantly reduce preventable morbidity among children.

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