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Inadequate diagnostic testing and systemic antifungal prescribing for tinea capitis in an observational cohort study of 3.9 million children, United States

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Keywords

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Tinea capitis (TC), a dermatophyte scalp and hair shaft infection, is an important public health concern. Confirmatory testing (eg, direct microscopy, fungal culture) before treatment is generally considered best practice because suspected TC has a broad differential diagnosis and treatment requires prolonged oral antifungal therapy.[1,2] Since national data on TC epidemiology, testing, and treatment practices are lacking, our objectives were to calculate TC incidence and describe testing and treatment practices for a large cohort of commercially insured children in the United States.

We analyzed Merative MarketScan Commercial Database (https://www.merative.com/real-world-evidence), selecting patients aged <18 years with ≥1 outpatient visit during July 1, 2016 to December 31, 2020, continuous insurance enrollment during the 180 to 365 days surrounding the first outpatient visit, and no TC diagnosis on or in the 180 days before the first outpatient visit. We calculated 1-year TC incidence, stratifying by demographic features. We identified TC cases and TC-related diagnostic testing using International Classification of Diseases, 10th Revision, code B35.0 and Current Procedural Terminology

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Note: This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy (for example, 45 C.F.R. part 46, 21 C.F.R. part 56; 42 U.S.C. §241(d); 5 U.S.C. §552a; 44 U.S.C. §3501 et seq).

Conflicts of interest

Dr Lipner has served as a consultant for Hoth Therapeutics, BelleTorus Corporation, and Orthodermatologics. Dr Gold, Author Benedict, and Dr Dulski have no conflicts of interest to declare.

codes. We compared diagnostic and treatment practices among specialties using χ^2 tests ($\alpha = 0.05$).

Among 3,929,156 patients, 1-year TC incidence per 10,000 person-years was 16.3 (95% CI, 15.9–16.7) (Table I). Incidence was highest among 5-year-olds (31.6; 95% CI, 29.1–34.0), males (20.9; 95% CI, 20.3–21.5), and Southern residents (22.5; 95% CI, 21.8–23.2).

Most patients with TC were diagnosed by pediatricians (54.6%), followed by dermatologists (11.7%) and family practitioners (10.4%) (Table II). Confirmatory testing was infrequent (21.9%), and the most common tests were fungal culture (17.8%) and direct microscopy (9.7%). Testing was more frequent among patients diagnosed by dermatologists (51.0%) than by pediatricians (16.4%) or family practitioners (11.0%) ($P < .01$).

Overall, 75.9% of patients were prescribed any antifungal, 61.2% were prescribed an oral antifungal (most frequently griseofulvin [52.7%]), and 14.7% were prescribed topical antifungal therapy alone. Patients prescribed topical therapy alone were more often diagnosed by family practitioners (22.1%) than by dermatologists (17.5%) or pediatricians (10.1%) ($P < .01$).

Most patients diagnosed with TC received no confirmatory laboratory testing, which is concerning because visual inspection alone of suspected cutaneous fungal infections can lead to diagnostic errors and unnecessary antifungal use.[3,4] Low testing rates might be due to Clinical Laboratory Improvement Amendments restrictions, long turnaround times, and low reimbursement rates. Guidelines recommend against using topical antifungals alone, due to lack of hair shaft penetration.[2] Since 38.8% of patients with TC were either prescribed topical treatment alone or not prescribed antifungals, there might be lack of knowledge about appropriate TC treatment, diagnostic uncertainty, and reluctance to prescribe systemic antifungals to children. The higher TC incidence among prepubescent and male children is consistent with previous studies.[5]

Study limitations include lack of information on race/ethnicity and non-commercial insurance types. Further, administrative data are subject to potential disease misclassification and undercoding, which might particularly affect reporting of diagnostic tests with low reimbursement rates (eg, direct microscopy). While dermatologists' use of diagnostic testing for TC exceeded other specialties, our study highlights important opportunities across all specialties to increase testing and ensure effective treatment for children with TC.

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Table I.

One-year incidence of tinea capitis among children aged <18 years—United States, July 1, 2016 to December 31, 2021

Characteristic	*n*	Population at risk	Incidence (per 10,000 person-years)	95% CI
Overall	6391	3,929,156	16.3	15.9–16.7
Age, y *				
<1	22	15,504	14.2	8.3–20.1
1	242	159,186	15.2	13.3–17.1
2	384	170,369	22.5	20.3–24.8
3	485	185,772	26.1	23.8–28.4
4	588	200,081	29.4	27.0–31.8
5	638	202,212	31.6	29.1–34.0
6	589	206,186	28.6	26.3–30.9
7	539	214,194	25.2	23.0–27.3
8	446	225,546	19.8	17.9–21.6
9	464	234,907	19.8	18.0–21.5
10	382	244,463	15.6	14.1–17.2
11	389	259,950	15.0	13.5–16.5
12	243	264,717	9.2	8.0–10.3
13	242	263,358	9.2	8.0–10.3
14	202	260,887	7.7	6.7–8.8
15	205	266,433	7.7	6.6–8.7
16	194	276,827	7.0	6.0–8.0
17	137	278,564	4.9	4.1–5.7
Sex				
Male	4177	1,998,956	20.9	20.3–21.5
Female	2214	1,930,200	11.5	11.0–11.9
US census region of residence				
South	3852	1,714,786	22.5	21.8–23.2
Midwest	1069	847,719	12.6	11.9–13.4
Northeast	921	662,445	13.9	13.0–14.8
West	512	682,985	7.5	6.8–8.1
Unknown	37	21,221	17.4	11.8–23.0
Urban-rural status of residence				
Non-rural	5750	3,498,945	16.4	16.0–16.9
Rural	608	413,537	14.7	13.5–15.9
Unknown	33	16,674	19.8	13.0–26.5

* Patient age at the beginning of the 1-year follow-up period. Median age at time of diagnosis was 7 years (interquartile range: 5 to 11).

Table II.

Diagnostic and treatment practices for tinea capitis in a cohort of commercially insured children, by diagnosing specialty*

Characteristic	Overall (*N* = 6391)	Pediatrician (*n* = 3487)	Dermatologist (*n* = 749)	Family practitioner (*n* = 662)	Unspecified or other (*n* = 1493)	*P* value
Diagnostic testing	1399 (21.9)	573 (16.4)	382 (51.0)	73 (11.0)	371 (24.8)	<.01
Fungal culture	1139 (17.8)	496 (14.2)	289 (38.6)	43 (6.5)	311 (20.8)	
Direct microscopy	617 (9.7)	232 (6.7)	184 (24.6)	34 (5.1)	167 (11.2)	
Antifungal susceptibility testing	108 (1.7)	42 (1.2)	24 (3.2)	10 (1.5)	32 (2.1)	
Skin biopsy	34 (0.5)	3 (0.1)	13 (1.7)	2 (0.3)	16 (1.1)	
Polymerase chain reaction	15 (0.2)	7 (0.2)	2 (0.3)	2 (0.3)	4 (0.3)	
Any antifungal drug	4853 (75.9)	2789 (80.0)	523 (69.8)	499 (75.4)	1042 (69.8)	<.01
Oral	3911 (61.2)	2437 (69.9)	392 (52.3)	353 (53.3)	729 (48.8)	<.01
Griseofulvin	3365 (52.7)	2282 (65.4)	253 (33.8)	252 (38.1)	578 (38.7)	
Terbinafine	353 (5.5)	88 (2.5)	112 (15.0)	57 (8.6)	96 (6.4)	
Fluconazole	208 (3.3)	74 (2.1)	30 (4.0)	47 (7.1)	57 (3.8)	
Itraconazole	4 (0.1)	1 (0.0)	0 (0.0)	0 (0.0)	3 (0.2)	
Topical	2290 (35.8)	1169 (33.5)	331 (44.2)	237 (35.8)	553 (37.0)	<.01
Ketoconazole	1818 (28.4)	955 (27.4)	260 (34.7)	176 (26.6)	427 (28.6)	
Clotrimazole	232 (3.6)	107 (3.1)	11 (1.5)	48 (7.3)	66 (4.4)	
Selenium sulfide	146 (2.3)	91 (2.6)	13 (1.7)	13 (2.0)	29 (1.9)	
Econazole	98 (1.5)	48 (1.4)	20 (2.7)	10 (1.5)	20 (1.3)	
Other topical antifungal	127 (2.0)	26 (0.7)	54 (7.2)	12 (1.8)	35 (2.3)	
Combination antifungal and corticosteroid creams	95 (1.5)	31 (0.9)	7 (0.9)	27 (4.1)	30 (2.0)	<.01
Oral therapy only	2563 (40.1)	1620 (46.5)	192 (25.6)	262 (39.6)	489 (32.8)	<.01
Topical therapy only	942 (14.7)	352 (10.1)	131 (17.5)	146 (22.1)	313 (21.0)	<.01
Received testing and oral antifungal therapy	757 (11.8)	376 (10.8)	198 (26.4)	46 (6.9)	137 (9.2)	<.01

*Data shown as no. (%). Patients could receive more than 1 type of diagnostic test and more than 1 type of treatment. Diagnostic tests were considered tinea capitis—related if they were documented within 90 days before to 0 to 7 days after the tinea capitis diagnosis date. Antifungal drug prescriptions were considered tinea capitiserelated if they were documented within 0 to 7 days after the incident tinea capitis visit date. Diagnostic tests were identified using the following Current Procedural Terminology codes: fungal culture (87101, 87102, 87106, 87107), direct microscopy (87210, 87220, 87206), antifungal susceptibility testing (87186), skin biopsy (11100, 11102, 11103, 11104, 11105, 11106, 11107), and polymerase chain reaction (87481, 87798, 87800, 87801).