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Epidemiological study of tinea capitis in schoolchildren in the Nablus area (West Bank)

Zur Epidemiologie der Tinea capitis bei Schulkindern im Raum Nablus (West Bank)

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Schlüsselwörter. Tinea capitis, Epiemiologie, Schulkinder, West Bank.

Summary. A study of tinea capitis was carried out during the period January–June 1996 in 7525 primary schoolchildren aged 6–14 years comprising 4050 boys and 3475 girls in the Nablus district in the Palestinian area. Fourteen primary schools located in rural, urban and refugee camp areas were surveyed in this study. Seventy-five (1.0%) mycologically proven cases of tinea capitis were detected. The incidence was higher in schools in rural areas (1.9%) than in refugee camps (1.1%) or urban areas (0.4%). Also, the incidence was higher in young children (1.4%) aged 6–10 years than in older children (0.5%) aged 10–14 years. Boys 52 (1.3%) were more commonly affected than girls 23 (0.7%). Higher disease incidence was found to be correlated with larger family and class sizes. *Trichophyton violaceum* was the most common aetiological agent (82.7%) followed by *Microsporum canis* (16%) and *Trichophyton schoenleinii* (1.3%). The findings are discussed in relation to the children's different socioeconomic and hygienic backgrounds. A mycological investigation carried out on 117 tinea capitis cases at a clinic in the area under study showed similar results to those of the school survey.

Zusammenfassung. In der Zeit von Januar bis Juni 1996 wurden 7525 Grundschulkinder am Alter von 6–14 Jahren (4050 Knaben und 3475 Mädchen) im Bezirk Nablus, Palästina, auf Tinea capitis untersucht. Die Schüler gehörten 14 Grundschulen in städtischen und ländlichen Gebieten sowie in Flüchtlingslagern an. In diesem Kollektiv wurden 75 Fälle (1.0%) von Tinea capitis aufgedeckt. Die Inzidenz war in ländlichen Schulen mit 1.9% höher als in Flüchtlingslagern (1.1%) und im städtischen Umfeld (0.4%). Auch war die Inzidenz bei jüngeren Kindern der Altersklasse 6–14 Jahre mit 1.4% höher als bei 10–14-Jährigen mit 0.5%. Knaben waren mit 52 Fällen (1.3%) häufiger befallen als Mädchen mit 23 Fällen (0.7%). Die höhere Inzidenz war zudem mit höherer Familienstärke und Klassengröße korreliert. *Trichophyton violaceum* war der häufigste Erreger (82.7%), gefolgt von *Microsporum canis* (16%) und *Trichophyton schoenleinii* (1.3). Die Befunde wurden auf die unterschiedlichen sozioökonomischen und hygienischen Verhältnisse bezogen. Eine Studie an Tinea capitis Patienten in einer Klinik des gleichen Gebiets erbrachte vergleichbare Resultate wie die Erhebung in den Schulen.

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Introduction

Mycotic infection of the scalp (tinea capitis), the most common of all mycoses in children, has been an important public health problem for several decades [1–4]. The disease is known to spread easily, especially among family members and among schoolchildren [5, 6]. This was attributed, partly, to infected fomites and the asymptomatic carrier state [1, 7].

The past four decades have seen marked changes in the relative prevalence of individual species of *Trichophyton* and *Microsporum* in different countries [2]. In the West Bank (Palestinian area) during the 1980s there was a preponderance of scalp infections in children caused by *T. violaceum* and the animal pathogen *M. canis* [8]. Only a few

reports on dermatophytic infections in the Palestinian area, based on patients examined in dermatology clinics in Nablus, have been carried out [8, 9].

School surveys are desirable to obtain homogeneous data on the prevalence of the disease and its aetiological agents. The present study was therefore carried out to obtain adequate data on tinea capitis in schoolchildren, and its causal agents in the Nablus area. An attempt was also made to compare the findings with those of previous reports from the same area. It was hoped that this would reveal any possible changes in the relative prevalence of causative agents that might have taken place in the past decade since the first report on tinea capitis in the Palestinian area was made. The work was also aimed at studying the effect of family size, socioeconomic conditions and some other factors on the prevalence of tinea capitis in schoolchildren in the area under study.

Subjects, materials and methods

Fourteen primary schools in the Nablus district were selected to represent different hygienic conditions, habitats and socioeconomic backgrounds (i.e. urban, six schools; refugee camp, four schools; and rural, four schools). The schools were surveyed for tinea capitis infections on two occasions in 1996, one in January and another in June, to account for possible seasonal fluctuations in disease incidence with the assumption that the highest numbers occurred in the winter and spring months and that the lowest numbers occurred in the summer months [9]. The first to eighth grade classes (195 classes) were chosen for examination at each school. The total number of children examined was 7525 aged 6–14 years, comprising 4050 boys and 3475 girls.

The survey procedure involved clinical inspection of the children's scalps, and the number of children with clinical signs of tinea capitis was recorded; the results of the two sampling occasions were combined. In all cases, details were taken of age, sex, parents' profession, family size and presence of animal pets or domestic animals in the child's environment.

Each lesion from each suspected case was then thoroughly cleaned with 70% ethyl alcohol, and skin scrapings and hair were collected from the edge of the lesion using heat-sterilized razor blades. Specimens were wrapped in sterile brown-paper packets and transported to the laboratory and processed the same day or within 48 h of collection.

Direct microscopic examination for each specimen was carried out using 10% KOH solution to check for the presence of hyphae and/or arthrospores. A portion of each sample was cultured on two slopes of Sabouraud glucose agar supplemented with chloramphenicol (0.05 mg ml^{-1}) and cycloheximide (0.5 mg ml^{-1}). Cultures were then incubated at 24–25 °C, regularly examined up to 3 weeks and identified using standard methods [10].

Cases in clinics

Scalp scrapings were also collected from 117 cases of tinea capitis at the Arda Clinic in Nablus in the period between January and July 1996. It was hoped that these cases would provide a wider spectrum of tinea capitis agents in the area of study. The specimens were processed as described above.

Results

Incidence of tinea capitis in schoolchildren

Out of 7525 schoolchildren examined, 75 (1.0%) had mycologically proven tinea capitis, 48 of these cases occurring in January and 27 in June 1996. Direct demonstration of fungal elements in skin scrapings and hair was positive in 75 (73.5%) of the suspected cases (102). The incidence of mycologically proven cases of tinea capitis according to age and sex is given in Table 1. Disease incidence was significantly higher in younger age groups (6–8 and 8–10 years; 1.2–1.6%), than in older age groups (10–12 and 12–14 years; 0.7–0.2%) ($\chi^2 = 14.418$, d.f. = 1, $P < 0.001$). The infection rate was also higher in boys (52, 1.3%) than in girls (23, 0.7%; $\chi^2 = 22.427$, d.f. = 1, $P < 0.001$). Also, there was a higher infection rate in rural area schools (1.9%) than in refugee camps (1.1%) or urban (0.4%) areas ($\chi^2 = 28.931$, d.f. = 2, $P < 0.001$) (Table 2).

Distribution of aetiological agents in affected schoolchildren according to age, sex, and locality

Tables 1 and 2 show the distribution of dermatophytes with respect to age, sex and locality of schoolchildren with tinea capitis. *T. violaceum* was the most prevalent aetiological agent of tinea capitis, regardless of age or sex: it was responsible for 82.7% of cases in schoolchildren ($\chi^2 = 126.84$, d.f. = 2, $P < 0.001$). *Microsporum canis*, a zoophilic dermatophyte, was the second most common aetiological agent: it was responsible for 16.0% of cases. Based on mycological study, there was no clear correlation between locality and frequency

Table 1. Dermatophytes isolation with respect to age and sex in schoolchildren with tinea capitis

Dermatophyte	Age (years)/sex								Total		Total number of isolates	Per cent of positive isolates
	6–8		8–10		10–12		12–14		M	F		
	M	F	M	F	M	F	M	F				
T. violaceum	11	9	20	6	7	7	1	1	39	23	62	82.7%
M. canis	7	0	4	0	1	0	0	0	12	0	12	16%
T. schoenleinii	0	0	1	0	0	0	0	0	1	0	1	1.3%
Totals	18	9	25	6	8	7	1	1	52	23	75	
Total/age group	27		31		15		2		75			
Total examined	21	73	19	97	22	1	11	54	75	25		

Table 2. Dermatophytes distribution of tinea capitis infection in schoolchildren

Localities*	Dermatophytes (%)			Total (%)
	T. violaceum	*M. canis*	*T. schoenleinii*	
Urban	11 (84.6%)	2 (15.4%)	0	13 (0.4%)
Rural	38 (100%)	0	0	38 (1.9%)
Refugee camps	13 (54.2%)	10 (41.7%)	1 (4.1%)	24 (1.1%)
Total	62 (82.7%)	12 (16%)	1 (1.3%)	75

*Total numbers of schoolchildren examined: urban 3302; rural 1971; refugee camp 2252.

of distribution of the isolated dermatophytes. *T. violaceum* was the most frequently isolated species from all localities, followed by *M. canis* and *T. schoenleinii* (Table 2).

Distribution of tinea capitis cases (89 mycologically proven cases) from clinics and their aetiological agents according to age, sex and locality

The results were similar to those obtained from the school survey; the incidence was higher in younger children aged up to 10 years (80/89, 90%) than in older children aged >10 years (10%) $\chi^2 = 31.517$, d.f. = 2, $P < 0.001$) and higher in boys (56.2%) than in girls (43.8%) ($P = 0.099$) (Table 3) and in rural areas (59.5%) than in other areas studied ($\chi^2 = 20.859$, d.f. = 3, $P < 0.001$) (Table 4). Also, *T. violaceum* was the most prevalent tinea capitis aetiological agent (64.1%) followed by *M. canis* (30.3%), *T. mentagrophytes* (4.5%) and *T. schoenleinii* (1.1%) ($\chi^2 = 120.734$, d.f. = 3, $P = < 0.001$) (Table 3).

Families with between 1–3 children had lower prevalence rates than families with four or more children ($\chi^2 = 88.4$, d.f. = 1, $P < 0.0001$); 92% of the infected children came from the latter type of families. Also, large classes (30–60 per class; 59 classes) had a higher prevalence than smaller classes (<30 per class; 16 classes) ($\chi^2 = 47.04$, d.f. = 1, $P < 0.0001$).

Discussion

Although tinea capitis is one of the earliest described human infections, and in spite of many years of experience with medical treatment, it is still widely distributed throughout the world and still continues to plague mankind [11].

In the Palestinian area (Nablus district), previous work on tinea capitis infection [12] showed that disease incidence rates (based on clinical signs only) in 1978 were 15%, 3.0% and 1.8% among schoolchildren in rural, refugee camps and urban areas respectively. The present study, constituting the first comprehensive epidemiological survey of tinea capitis in schoolchildren in the Nablus district, reports incidence rates of 1.9%, 1.1% and 0.4% (based on mycologically proven cases) in rural areas, refugee camps and urban areas respectively. This may be partly due to differences in socioeconomic and hygienic conditions with higher incidence is associated with lower socioeconomic and hygienic conditions, e.g. in rural areas [13, 14]. In fact, about 73.3% of all cases in the present study came from working class families.

Table 3. Dermatophyte isolation with respect to age and sex in clinic tinea capitis patients

Dermatophyte	Age (years)/sex																Total number of isolates	Percent of positive isolates
	0–2		2–4		4–6		6–8		8–10		10–12		12–14		Total			
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F		
T. violaceum	0	0	3	3	12	11	8	9	3	2	2	3	1	0	29	28	57	64.1%
M. canis	0	1	3	1	4	4	6	2	3	1	2	0	0	0	18	9	27	30.3%
T. mentagrophytes	0	0	0	0	0	0	1	1	1	1	0	0	0	0	2	2	4	4.5%
T. schoenleinii	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	1.1%
Totals	0	1	6	4	16	15	15	12	7	4	4	3	2	0	50	39	89	
	1		10		31		27		11		7		2		89			

Table 4. Dermatophyte distribution of tinea capitis infection in clinic children

Localities	Dermatophytes (%)				Total (%)
	T. violaceum	*M. canis*	*T. mentagrophytes*	*T. schoenleinii*	
Urban	9 (56.2%)	6 (37.5%)	1 (6.3%)	0	16 (18.0%)
Rural	35 (66%)	16 (30.2%)	1 (1.9%)	1 (1.9%)	53 (59.5%)
Refugee camps	13 (65%)	5 (25%)	2 (10%)	0	20 (22.5%)
Total	57 (64.04%)	27 (30.33%)	4 (4.5%)	1 (1.13%)	89

Table 5. Distribution of tinea capitis infections in children according to family size

Number of children in each family	Number of families (%)	Total number of children in the families	Total number of infected children (%)	% of total infected children
One to three	6 (9.1%)	16	6 (1.0%)	8%
Four or more	60 (90.9%)	318	69 (1.15%)	92%
Total	66	334	75 (1.14%)	

A decrease in incidence rates of ringworm infection in schoolchildren between 1978 and 1996 in the Palestinian area may therefore be attributed to improvements in the above-mentioned conditions. This finding is in agreement with that of Oyeka [15], who found poor sanitary living conditions and overcrowding to be factors favouring occurrence of tinea capitis in the area he studied.

Furthermore, in the current work, overcrowding, as a result of large family size, was shown to favour the occurrence of tinea capitis. This is in agreement with the findings of those of a similar study in Nigeria by Ajao & Akintunde [13].

A higher incidence of disease in children aged 6–10 years (1.4%) than in children aged 10–14 years (0.5%) conforms to the widely held view that the majority of cases of tinea capitis occur in children below the age of 10 years [13, 15–18]. Boys (1.3%) were more commonly affected than girls (0.7%) in the present work, and this is in agreement with many other similar studies [15, 16]. This has been mainly attributed to the sensitivity of dermatophytes to certain sebaceous gland secretions that first appear at puberty and persist into adulthood, especially in men [19, 20]. This sensitivity could also explain the greater incidence of tinea capitis in boys (boys normally reach puberty later) than in girls [21].

The dermatophytes shown by this survey to be the main cause of mycotic infection of the scalp in the Nablus district are generally those that have been reported previously as the commonest in this area [8, 9].

However, comparison of the data on aetiological agents of tinea capitis from this work, based on cases from schoolchildren and from the clinic (164 mycologically proven cases), with those obtained in 1986 (217 mycologically proven cases) [8] reveals an escalation in the anthropophilic fungus

T. violaceum as the most common aetiological agent of tinea capitis cases in the Nablus district (from 49.8% of total isolates in 1986 to 72.6% in 1996) and a decrease in the role of the zoophilic *M. canis*, the second leading dermatophyte, as a causative agent of tinea capitis (from 31.8% to 23.8%), *T. mentagrophytes* (from 3.7% to 2.4%) and *T. schoenleinii* (from 8.7% to 1.2%). This rise in the incidence of anthropophilic fungi means that there has been a trend towards more infections transmissible among children, with *T. violaceum* being the commonest organism. Our findings are in agreement with recent observations of several workers [22–24], who have reported a significant rise in the incidence of infections due to anthropophilic dermatophytes (*T. tonsurans*) and a decreasing importance of the zoophilic *M. canis* [3] in childhood tinea capitis. In addition to school as an important source of infection, home might be an even more important source, especially in families with asymptomatic carriers of *T. violaceum* or *T. tonsurans* [25, 26]. Asymptomatic individuals with high spore loads may be a more important vector in the transmission of scalp ringworm because they have the potential to shed large numbers of spores over long periods of time [26].

Anthropophilic species seem to become increasingly prominent as tinea capitis causative agents in this area, whereas the zoophilic *M. canis* is on the decline. Further investigation over the course of several years will be needed to determine whether these changes reflect a continuing trend. The fluctuations in the aetiology of tinea capitis are believed to be the result of factors attributable to the environment, human migratory patterns, new therapies, the pathogen and the host [27, 28]. However, none of these factors can adequately explain the current increase in anthropophilic dermatophytic infections.

Trichophyton violaceum and *M. canis* were also reported to be the predominant scalp ringworm pathogens in many countries of the Near East, including Iraq [29], Saudi Arabia [18], Kuwait [30], Egypt [31] and Iran [32]. *Trichophyton violaceum* is also predominant on the Indian subcontinent [17, 33].

In neighbouring Israel, *M. canis* was first reported in 1975 [34–36]. Since then, this dermatophyte has spread throughout the country becoming an important cause of scalp ringworm [37, 38]. However, it is not known if that reflected a continuing trend. However, in some other Mediterranean countries, e.g. Italy, this zoophilic dermatophyte has become increasingly prominent, whereas anthropophilic species, e.g. *T. violaceum*, have either disappeared or are in decline [28]. This was attributed in part to the ecological and biological characteristics of *M. canis*, namely its *in vivo* resistance to antimycotics [39, 40] and its ability to survive and even grow better in xerophilic conditions. This last characteristic explains its widespread distribution in animals with fur [41–44], and therefore facilitates its transmission through superficial contacts between man and animals, and between humans [28]. The significance of animal reservoirs in the epidemiology of tinea capitis in the Palestinian area has been demonstrated in previous studies on animal hair mycoflora. The findings demonstrated the wide distribution of several dermatophytes, including *M. canis* and *T. mentagrophytes*, on the hair of different healthy animals, including cats, dogs, cattle, sheep, goats and others surveyed in previous studies in the Palestinian area [42–44].

Fluctuations in the appropriate animal population are generally associated with corresponding fluctuations in the incidence of human infections [41]. This may partly explain the present decline in *M. canis* as a cause of tinea capitis in this area, where a decline in animal populations has been observed in the last few years.

Further work is needed to determine the prevalence of asyptomatic carrier state of tinea capitis in schoolchildren in the Palestinian area and to assess its significance in the spread of infection and identify factors that affect this state.

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