Lice, Nits, and School Policy

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ABSTRACT. *Background.* **The epidemiology of head lice infestation is poorly understood. Many schools treat all children with nits as though they are contagious. Children with nits but no lice are often removed from school until they are treated and all visible nits are removed.**

Objective. **To investigate the probability that children with nits alone will become infested with lice.**

Design. **Prospective cohort study.**

Setting. **Two metropolitan Atlanta elementary schools.**

Participants. **A total of 1729 children were screened for head lice. Twenty-eight children (1.6%) had lice, whereas 63 (3.6%) had nits without lice. Fifty of the 63 children (79%) with nits alone completed follow-up.**

Outcome Measure. **Conversion (ie, becoming infested with lice) within 14 days after initial screening.**

Results. **Nine of 50 children (18.0%) followed for nits alone converted. Although children who converted did not have significantly more nits than did nonconverters, having nits near the scalp was a risk factor for conversion. Seven of 22 children (31.8%) with ≥5 nits within one fourth inch of the scalp converted, compared with 2 of 28 children (7.1%) with fewer (relative risk: 4.45; 95% confidence interval: 1.03–19.35). This risk remained statistically significant after separately stratifying for sex, recent treatment, and total number of nits.**

Conclusions. **Although having ≥5 nits within one fourth inch of the scalp was a risk factor for conversion, most children with nits alone did not become infested. Policies requiring exclusion from school and treatment for all children with nits alone are likely excessive. Instead, these children may benefit from repeated examination to exclude the presence of crawling lice.** ***Pediatrics*** **2001;107:1011–1015;** ***lice, pediculus, lice infestations, pediatrics, school.***

ABBREVIATIONS. CI, confidence interval; RR, relative risk.

Infestation by the head louse, *Pediculus humanus* var *capitis*, is a common problem among children; the United States has an estimated 6 to 12 million cases annually.[1] However, despite this frequency, there is not agreement as to what constitutes an infestation. Some studies have defined an infestation as the presence of lice, whereas others have used the presence of either nits or lice.[2–5]

Because nits are simply egg casings that can contain a developing embryo or be empty shells, not all nits are infective.[6] Moreover, not all persons with nits have lice. Nits are firmly attached to the hair shaft and can persist long after adequate treatment.[6] Unfortunately, the likelihood that nits will develop into lice is not known.

Faced with this uncertainty, some groups have advocated no nit policies, which many schools have subsequently adopted.[7–9] Even in the absence of lice, children in schools with no nit policies are excluded from school until they are treated with a pediculicidal agent and have had all visible nits removed. Because some of these children will not become infested, these policies may lead to unnecessary pesticide exposure, missed school, and loss of work for parents.

Some investigators consider that nits close to the scalp contain developing louse embryos.[3,10,11] This premise relies on the following assumptions: an adult female louse will attach her eggs near the base of a hair; human hair grows approximately one half inch per month; and the louse egg incubation time is 6 to 9 days.[6,12] In 1 study, only 22% of children with nits within one fourth inch (0.6 cm) of the scalp were found to have lice after a thorough examination of the scalp and hair.[13] This suggests that even having nits close to the scalp does not necessarily indicate that lice are currently present. However, if nits close to the scalp do contain developing embryos, we expect that the risk of becoming infested would depend on the location of the nits. We know of no study demonstrating such a relation.

To determine the likelihood of becoming infested with lice as a result of having nits, we followed children in 2 schools that did not remove children from school for nits alone. Children found to have nits were categorized by total number of nits, as well as the number of nits within one fourth inch of the scalp, to see whether either predicted the likelihood of developing an infestation.

METHODS

Study Population

Between September 2, 1998, and October 20, 1998, the Georgia Division of Public Health and local school health officials examined children for head lice at 2 metropolitan Atlanta elementary schools (kindergarten to fifth grade). These schools and the school district were chosen for their willingness to participate in the study. The cumulative racial/ethnic distribution for these schools

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was 89% white, 3% black, 5% Hispanic, 1% Asian, and 2% other. Consent forms were sent home to all 2049 children in school A (769 children) and school B (1280 children) for parental review and consent. Only children who returned a consent form signed by a parent or guardian were screened as part of the study.

Screening Procedures and Case Definitions

Parent volunteers, school nurses, and members of the study team screened the children. All persons screening children were instructed on head louse screening. Screeners were shown pictures and actual samples of nits and head lice, and they received instruction on examining the hair and scalp. To screen for the presence of nits and lice, the child's scalp and hair were examined in quadrants. Hair was examined in 1-cm increments using applicator sticks, which facilitated hair separation. Children found to have a living nymph or adult head louse in their hair were considered actively infested, whereas children found to have nits but no lice on initial screening had 2 additional 5-minute examinations by members of the study team to exclude the presence of lice. Children with live head lice on these subsequent examinations were also considered infested. For children with nits alone, the total number of nits and the number of nits within one fourth inch of the scalp were counted. Children were grouped by whether they had ≥5 nits within one fourth inch of the scalp. This assignment required the agreement of 2 independent examiners; a third examiner settled disagreement. In comparison, total nit counts were counted and rounded up to the nearest multiple of 5. An average nit count was calculated when the counts from the 2 examinations differed. The crude interobserver agreement was 93% for 136 consecutive total nit counts.

Study Design

The institutional review boards of the Centers for Disease Control and Prevention and the Georgia Department of Human Resources approved this study. The parents of all children found to have nits and/or lice were notified. According to school policy, all children found to have lice had to be picked up from school by their parents, and proof of treatment was needed for the child to be readmitted the next day. Exclusion from school and treatment with a pediculicide was not required for those children found to have nits alone, although parents could treat their children as they saw fit. Parents of children with nits alone were asked to permit additional follow-up examinations. Only children with parental consent for additional follow-up examinations were examined on days 1, 7, and 14. Each follow-up consisted of two 5-minute examinations by different members of the study team. Children were also examined immediately if they were symptomatic at any time in this 14-day period. The 2 endpoints of the study were the finding of a louse or being lice-free during the 14-day follow-up. Any child found to have a nymph or adult louse at any time in the 2-week follow-up was considered a converter. If no louse was found, a child had to at least have follow-up examinations on day 14 and on either day 1 or day 7 to be included in the analysis; otherwise, he/she was considered lost to follow-up. The total number of nits on a child's head was counted again when he/she reached one of the study endpoints.

Questionnaire

Parents of children with nits and/or lice were asked to complete a questionnaire. Questions concerned basic demographic data, the child's history of previous lice treatments, infestation among other household members, and the presence of other potential risk factors. The parents of children found to have lice on initial screening were asked to complete the questionnaire when they picked up the children from school. The parents of children followed for nits were asked to complete the questionnaire when their child reached one of the study endpoints. These latter parents were also asked whether their child had been treated for head lice during the follow-up.

Statistical Analysis

Conversion to active infestation was the primary outcome measure. Comparison of groups was performed using χ^2 test, Student's t test, and Fisher's exact test where appropriate. Data were analyzed in *EpiInfo, Version 6.0* (Centers for Disease Control and Prevention, Atlanta, GA) using a .05 significance level.[14] Confidence intervals (CIs) for the relative risk (RR) were computed using the method of Greenland and Robins.[15]

RESULTS

Of the 2049 children in the 2 participating schools, 1729 (84.4%) returned the signed consent form and were screened for head lice (Fig 1). After screening and initial examination, 91 children (5.3%) were found to have nits alone or lice. All 28 children with lice also had nits; therefore, 30.8% of the children with nits were also found to have lice. Of the 811 girls screened, 71 (8.7%) were found to have lice or nits compared with 20 of the 918 boys (2.2%; RR = 4.02; 95% CI = 2.47–6.54). Similarly, 6.0% of girls (49) were found to have nits alone compared with 1.5% of boys (14; RR = 3.96; 95% CI = 2.20–7.12).

Of the 63 children identified with nits alone, 50 (79.4%) completed the study. Of the remaining 13 children, either their parents did not consent for follow-up examinations (n = 5) or they were enrolled but considered lost to follow-up (n = 8). Questionnaires were completed for 81 of the 91 children (89.0%) with either nits alone or lice.

The baseline characteristics of children with lice and children with nits alone are shown on Table 1. The 2 groups are similar except that children with lice had significantly more nits. Fifty-nine of 81 children (72.8%) reported receiving treatment for head lice in the previous year, and 25 of 76 (32.9%) reported receiving treatment within the 14 days before screening. Children who had received treatment in the previous year had been treated an average of 4.3 times (range: 1–15) during the year. Among children with lice or nits, 41 of 80 (51.2%) reported that other family members had been affected by head lice within the past year.

Of the 50 children followed for nits, 9 (18.0%) became infested with lice during the 14-day follow-up. Seven of 22 children (31.8%) with 5 or more nits within one fourth inch of the scalp developed an infestation, compared with 2 of 28 children (7.1%) with <5 nits within one fourth inch of the scalp (RR = 4.45; 95% CI = 1.03–19.35; Table 2). This significant difference was maintained after separately stratifying for sex (adjusted RR = 4.70; 95% CI = 1.02–21.75), treatment within previous 14 days (adjusted RR = 8.10; 95% CI = 1.08–49.73), and total

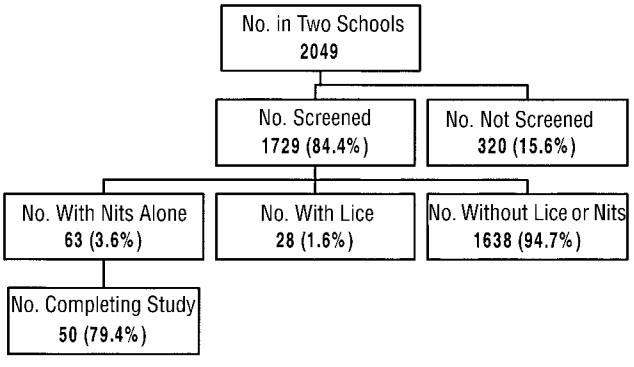

Fig 1. Study population at 2 metropolitan Atlanta schools: the number of children screened, the number with nits alone or lice, and the number with nits alone who completed the study in 1998.

TABLE 1. Characteristics of 91 Children With Lice and With Nits Alone in Two Metropolitan Atlanta Elementary Schools, 1998*†

	Children With Lice (n = 28)	Children With Nits Alone (n = 63)
Female	78.6% (22/28)	77.8% (49/63)
Age (y)	7.6 ± 1.5	7.2 ± 1.6
Treated in the previous y	73.1% (19/26)	72.7% (40/55)
Treated in the previous 14 d	47.8% (11/23)	26.4% (14/53)
Children in household	2.7 ± 1.3	2.9 ± 1.2
Family history of lice‡	46.2% (12/26)	53.7% (29/54)
Shares bed with family member	54.2% (13/24)	40.0% (22/55)
Shares brushes/combs with others	43.5% (10/23)	58.2% (32/55)
Number of nits	44 ± 27	20 ± 16§

* Denominators represent the total number of children for whom data exist.
† Plus–minus values are means ± standard deviation.
‡ Other family members reported to have had lice in the preceding year.
§ $P < .05$.

TABLE 2. Effect of Location and Number of Nits on Risk of Becoming Infested With Lice Within 14 Days Among Children With Nits Alone at Two Metropolitan Atlanta Elementary Schools, 1998*

Characteristic	Infested (%)	RR (95% CI)
≥5 nits within one fourth in of scalp	7/22 (31.8%)	4.45 (1.03–19.35)
<5 nits within one fourth in of scalp	2/28 (7.1%)	Referent group

* Denominators represent the total number of children within each category who were followed until reaching a study endpoint.

number of nits (adjusted RR = 4.46; 95% CI = 1.03–19.29).

Thirty-nine of the 50 children (78.0%) who completed the study had their total number of nits counted initially and when they reached one of the study endpoints. Five of these 39 children (12.8%) converted and 34 (87.2%) did not. The total number of nits found on initial examination did not predict whether a child would become infested. The average initial nit count among children who converted was 30 and the average initial nit count among children who did not convert was 18; the average nit counts were not statistically different (P = .16). During follow-up, converters had a mean increase of 6 in their total number of nits, whereas nonconverters had a mean decrease of 6 in their total number of nits; these changes were not statistically different (P = .07). At study end, 4 children (11.7%) were not found to have nits; these 4 children were nonconverters.

To determine whether other potential risk factors were associated with becoming infested, we compared children who converted with those who remained lice-free for the full 14-day follow-up (Table 3). Although girls were more likely than were boys to have nits, girls with nits were not more likely to convert compared with boys with nits (RR = 0.99; 95% CI = 0.24–11.15). Similarly, the other factors related to transmission were not found to be significantly associated with conversion. These included sharing a bed with other family members; sharing hair care items, such as brushes or combs; and having a history of others affected in the household.

TABLE 3. Evaluation of Potential Risk Factors and Protective Factors for Conversion Among 50 Children With Nits Alone at Two Metropolitan Atlanta Schools, 1998

Characteristic	RR (95% CI)
Female	0.99 (0.24–4.09)
Sharing a bed with other family members	3.16 (0.89–11.15)
Sharing combs or brushes with others	1.27 (0.36–4.47)
Family history of lice	2.14 (0.48–9.55)
Treatment in the previous 14 d	3.49 (0.90–13.50)
Treatment during follow-up	3.00 (0.97–9.30)

Of the 50 children who completed the study, 13 (26.0%) were treated with a pediculicide within 14 days before initial screening and 7 (14.0%) were treated by their parents during the follow-up. Receiving treatment during these periods was not protective (Table 3). A larger proportion of children treated within 14 days before screening than of children not so treated converted (RR: 2.69; 95% CI: 0.79–9.22), and a larger proportion of children treated during follow-up than of children not so treated converted (RR: 3.00; 95% CI: 0.97–9.30). These differences were not statistically significant.

DISCUSSION

In a study by Donnelly et al,[7] two thirds of school nurses who responded to their questionnaire stated that they had a no nit policy. By their definition, a no nit policy required all children found to have nits and/or lice to be excluded from school until they were treated with a pediculicidal agent and had all visible nits removed.

In this study we found that the presence of nits did not imply an ongoing active infestation with lice; on initial screening, only 31% of children with nits had lice. Furthermore, not all children with nits became infested; only 18% of children with nits alone developed lice over the next 14 days.

Consistent with the hypothesis that lice lay their eggs near the base of the hair, children with 5 or more nits within one fourth inch of the scalp were significantly more likely than were those with less to develop an infestation. However, even in these higher risk children, only 32% became infested. Re-

gardless of the location of nits, excluding children with nits alone from school would have caused many children to miss school unnecessarily.

Because some nits contain developing lice, it seems intuitive that removing nits would reduce the risk of infestation. Unfortunately, nit removal is often difficult in practice.[16] Nits are firmly attached to hair, making removal painful.[12,17] Also, despite a parent's vigilance some nits may escape detection.[6,12,17] This study did not determine whether reductions in the number of nits during the study were the result of parents removing nits. Although nonconverters did have an overall reduction in their number of nits during the study, this change was not statistically different from the change in the number of nits for converters. Moreover, elimination of nits did not seem to be essential for children to remain louse-free, because only 12% of nonconverters were without nits at the end of follow-up.

In our study, 73% of children with lice or nits reported receiving a pediculicide within the past year, and during this time these children were treated an average of 4.3 times. Although we did not ask whether lice or nits prompted these treatments, our findings that most children with nits alone do not become infested suggest that some of children were treated unnecessarily.

Criteria for treatment have been addressed recently in the United Kingdom,[18] where the use of pediculicides is recommended only if a live louse is found and not for nits alone. None of the currently available pediculicides are completely ovicidal (ie, capable of killing all developing embryos within nits).[12,19–22] Therefore, in our study, children with nits alone may have had similar conversion rates regardless of whether they were treated initially with a pediculicide. Although our data are limited by the possible inaccuracy of treatment histories, children whose parents reported treating them before or during follow-up were not less likely to become infested than were children whose parents did not report such treatment. Most pediculicidal agents are safe if used properly,[23,24] but some may cause harm. Central nervous system toxicity and anemia have been reported after exposure to lindane.[25–27] Carbaryl, a pediculicide used in the United Kingdom, was restricted to prescription use after it was found to be a carcinogen in animal tests.[28]

In this study we did not attempt to discriminate between infestation from hatching nits and reinfestation from other persons. However, none of the factors related to transmission were found to be significantly associated with conversion.[29] This suggests that conversion resulted from the preexisting nits and not from transmission from others. Furthermore, because reinfestation would overestimate the risk of conversion from nits, our interpretations would remain valid even if reinfestation occurred.

There may be characteristics of nits other than their closeness to the scalp, which would indicate that they are recently laid eggs. For example, some investigators have used the presence of either an operculum or an eyespot as evidence of a nit containing a developing embryo.[22] Unfortunately, such criteria are probably impractical for screening children in schools. Moreover, because 10% to 30% of eggs do not hatch even in optimal conditions,[30] methods that solely attempt to determine whether a nit is an egg or an empty shell may not be useful in predicting subsequent conversion.

Most children with nits alone will not become infested; therefore, excluding these children from school and requiring them to be treated with a pediculicide is probably excessive. Because most available pediculicides are incomplete ovicides, treating children with nits alone may not prevent subsequent infestation. Rather than miss an entire day of school, children with nits could undergo a thorough 5- to 10-minute examination to exclude the presence of live lice. If they have no lice, children with nits could then have regular follow-up examinations during the next 14 days. Children with ≥5 nits within one fourth inch of the scalp are at higher risk for becoming infested and may need more frequent follow-up examinations. Such a change in school lice control policy from exclusion to inspection will require that persons in charge of screening children for head lice be trained in lice detection and be given adequate time to conduct thorough examinations. Although having parents remove nits manually may lower a child's risk of becoming infested, studies are needed to determine the efficacy of this intervention. There is no reason to believe that nit removal will only be accomplished if children miss school and parents miss work. Effective control of head lice will require rational, scientific approaches in an area that has long been dominated by fear and anecdote.

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THE LARGEST FRAUD SETTLEMENT TO DATE! HCA TO PAY $95 MILLION IN FRAUD CASE

The nation's largest hospital company, which for much of a decade awed Wall Street with its ability to wring huge profits out of a once-staid industry, has agreed to pay $95 million in criminal penalties and plead guilty to charges that it obtained some of its money by cheating government health care programs, the Justice Department announced.

The settlement with the company, HCA—The Healthcare Company—formerly known as the Columbia/HCA Healthcare Corporation—is a partial resolution of sprawling criminal and civil investigations into its business practices. With the announcement, HCA has agreed to pay a total of $840 million in criminal and civil penalties so far. While that amounts to the largest fraud settlement in American history, large portions of the civil investigation are left to be resolved.

Eichenwald K. *New York Times.* December 15, 2000

Noted by JFL, MD