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Epidemiology and Control of a Head Louse Outbreak in Ames, Iowa, 1976¹

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At the onset of school in 1976, head lice were recognized by teachers and school nurses in the public and parochial schools in Ames, Iowa. One or more cases were identified from the 9 elementary schools and 3 secondary schools in the community. The greatest prevalence of louse infestations occurred in 2 elementary schools (1 parochial) where 16% and 14%, respectively, of the students were infested. A program was established to screen children and exclude infested individuals from class until they were effectively treated. The community was surveyed to determine the extent of infestation in each household from which at least 1 member was attending school and had a confirmed louse infestation. Data were tabulated on the incidence of louse infestations by school, grade, sex, hair color, hair length, number of persons living in homes where louse infestations were recognized and incomes of families that had infested members. Factors that contributed to louse transmission and an evaluation of an intensive community-wide control program are discussed.

INDEX DESCRIPTORS: Head lice, pediculosis, *Pediculus humanus capitis*, epidemic, epidemiology.

Head louse infestations (pediculosis), although not reported formally to federal or state health authorities, have been recognized with increasing frequency during the past 10 years. The head louse, *Pediculus humanus capitis* De Geer, is a wingless, bloodsucking insect parasite found on the heads of people; it does not ordinarily live on any animal except man. Transmission occurs through close contact with an infested person or through contact with fomites such as coats, caps, scarfs, upholstered furniture, bedding, combs, brushes, and the like. Itching, the major symptom, results from the bloodsucking activity and may produce secondary bacterial infections. The head louse does not transmit louse-borne typhus, trench fever, or relapsing fever as does the body louse, *P. h. humanus* L. The life cycle involves an incomplete or gradual metamorphosis. Eggs or nits are attached to hair shafts with a cement. Eggs hatch in about 7 days and go through 3 nymphal (immature) stages before becoming adults in about another 3 weeks. Adults survive for about 1 month and produce 5 to 10 eggs daily (Pratt and Littig, 1973).

Outbreaks of head lice in school-age populations generally are regarded as difficult problems to control. The object of this investigation was to define factors that contribute to transmission and to evaluate the results of an intensive community-wide control program directed by school and public health officials.

BACKGROUND AND DESCRIPTION OF THE INVESTIGATION

Ames is a community of 40,000 population in Story County, 30 miles (48 km) north of Des Moines in Central Iowa. Major industries include several government agencies and a state university with 23,000 enrollment. The immediate surrounding area is rural, with a productive agricultural economy.

Preceding the start of the school year in the fall of 1976, head lice were reported only infrequently. At the start of school in September of 1976, infestations were recognized immediately by teachers and the school nursing staff in the 11 public schools and the 1 parochial school in the community. Initial efforts by school officials to have children treated were not completely successful and many cases were diagnosed

in early October, 1976.

At this time, state and county health authorities were notified and, with assistance from the Entomology Department of Iowa State University, set up a program of screening all children and excluding infested children from classes until effectively treated. Medical personnel at 2 large clinics in the community provided medical care. The staffs of these clinics were notified, and a standard treatment regimen was agreed upon. This included a preshampoo by a parent and treatment with a 1% lindane (gamma benzene hexachloride) shampoo or lotion, followed by combing out as many nits as possible. The treatment was repeated 7 to 10 days later to kill newly hatched nymphs (Slonka and McKinley, 1975; Orkin et al., 1976).

Recommendations were sent home with all pupils to screen all household members for evidence of lice. Instructions were included to wash bedding, launder or dry-clean all clothing, and disinfect all personal articles such as combs and brushes with hot water and a disinfectant. Media coverage was developed to underscore these recommendations and minimize any anxiety in the community.

A survey form was designed to determine the extent of infestation for every household which had at least 1 member attending school who had

Table 1. Incidence of head louse infestation by school, Ames, Iowa, September to December, 1976.

School	Number of students	Number of cases		Percent infestation
		Male	Female	
Crawford	174	0	1	0.6
Edwards	291	12	12	8.2
Fellows	465	2	2	0.9
Meeker	388	0	2	0.5
Mitchell	329	4	17	6.4
Northwood	297	5	2	2.4
Roosevelt	328	4	2	1.8
St. Cecilia	147	10	11	14.3
Sawyer	373	30	30	16.1
Central Junior High	711	3	1	0.6
Welch Junior High	662	2	3	0.8
Ames Senior High	1,340	0	7	0.5
TOTAL	5,505	72	90	2.0

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Table 2. Attack rates of pediculosis by age and sex in Ames, Iowa schools, September to December, 1976.

	Male			Female			Total		
	Infested	Total	Attack rate (%)	Infested	Total	Attack rate (%)	Infested	Total	Attack rate (%)
K	8	206	3.9	11	208	5.3	19	414	4.6
1	16	205	7.8	18	243	7.4	34	448	7.6
2	7	203	3.4	20	194	10.3	27	397	6.8
3	16	191	8.4	12	201	6.0	28	392	7.1
4	8	193	4.1	7	174	4.0	15	367	4.1
5	6	201	3.0	4	191	2.1	10	392	2.6
6	6	210	2.9	7	172	4.1	13	382	3.4
7	1	248	0.4	3	204	1.5	4	452	0.9
8	2	214	0.9	1	242	0.4	3	456	0.7
9	2	247	0.8	0	218	0.0	2	465	0.4
10	0	204	0.0	4	251	1.6	4	455	0.9
11	0	248	0.0	1	194	0.5	1	442	0.2
12	0	222	0.0	2	221	0.9	2	443	0.5
TOTAL	72	2,792	2.6	90	2,713	3.3	162*	5,505	2.9

*6 cases, 4 in nursery school and 2 in unknown grade, are not included in total.

a recognized louse infestation. The form asked for a household census including sex, number of bedrooms, income class, and members with recent or current head louse infestations. Hair color and hair length were determined for infested individuals. The former was classified as blonde, brown, red, and black. Hair length was classified as short — hair reaching to or partly covering the ears; medium — hair extending over the ears to the base of the jaw line; long — hair extending beyond the jaw line. County health nurses made home visits for special problems that included families with multiple cases and households with reinfestations or apparent treatment failures. In addition, the nurses visited non-English speaking households with louse problems and described the program in detail.

Entomology personnel from Iowa State University assisted with, and supervised, the screening of pupils. This consisted of direct inspection of the hair and scalp for the presence of adult lice as well as for immature forms and nits. Examination of the nape of the neck and the area behind the ears was emphasized. Some hair was parted with wooden applicator sticks to improve recognition of nits and crawling forms. Hand lenses, flashlights, and dissecting microscopes were used as aids in diagnosis. This procedure was repeated weekly from October to December.

Data from the screening program and household questionnaires were collected and analyzed according to standard statistical methods, including Chi-square tests, ratios, and risk factors as identified by percentage attack rates.

RESULTS

A total of 168 cases in an enrollment of 5,505 (3%) was identified from the beginning of the school year in September 1976 through December 1976. The highest incidence was observed in early October before control measures began to have an effect. No new cases were observed after the Christmas-New Year recess, indicating success of the control program.

A review of the school-based data showed that at least 1 or more cases were identified in all 9 elementary schools and 3 secondary

schools, attesting to the widespread involvement of the condition (Table 1). The greatest prevalence was noted in 1 public elementary school, Sawyer (16%) and the 1 parochial elementary school, St. Cecilia (14%). There were 81 (48%) infested children from these 2 schools. Inasmuch as St. Cecilia's enrolled pupils from the entire community and all public grade schools together reported cases encompassing the entire community, no particular area free of involvement could be identified. However, cases seemed to be concentrated in the area served by Sawyer.

The sex ratio of infested pupils was 1.3 females to 1.0 male. The 3 schools with the greatest prevalence, Edwards, Sawyer, and St. Cecilia, totaled 52 male and 53 female cases. Overall, there were more cases among females than among males, although this difference was not significant, Chi square = 2.38. Cases by grade are listed in Table 2. Except for kindergarten, cases decrease incrementally from the highest number of 34 in the 1st grade through 3 cases in the 8th grade. Only 16 (1%) high school students (grades 7-12) had head lice. The higher attack rate in grades K-6 was significant, Chi square = 102.08, $p > 0.0001$. Hair color is tabulated and summarized in Table 3. Cases were concentrated in children with blonde and brown hair as compared with children with red and black hair. Hair length is summarized by sex in Table 4 and shows cases predominating in individuals with short and medium length hair. Because denominator data were not available, no additional analyses were performed on these traits.

Table 3. Hair color of louse-infested individuals in Ames, Iowa schools, September to December, 1976.

	No. individuals with head lice				Total
	Blonde	Brown	Red	Black	
Male	32	43	2	2	79
Female	31	43	7	8	89
Total	63	86	9	10	168
Percent	37.5	51.2	5.4	5.9	100

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Table 4. Hair length of louse-infected individuals in Ames, Iowa schools, September to December, 1976.

	Hair Length			Total
	¹ Short	² Medium	³ Long	
Male	39	39	1	79
Female	17	29	43	89
Total	56	68	44	168
Percent	33.3	40.5	26.2	100

¹Short: Hair reaching to or partly covering the ears.

²Medium: Hair extending over the ears to the base of the jaw line.

³Long: Hair extending beyond the jaw line.

Table 5. Number of persons living in home of louse-infected individuals in Ames, Iowa, September to December, 1976.

	No. in Household							Total
	2	3	4	5	6	7	8	
Male	0	6	23	24	16	7	3	79
Female	3	7	36	17	14	8	4	89
Total	3	13	59	41	30	15	7	168
Percent	1.8	7.7	35.1	24.4	17.9	8.9	4.2	100

When household factors are considered, the likelihood of cases occurring in homes with 4 or more individuals is greater than in households with 3 or 2 household members (Table 5). This observation is complemented by the fact that 58% of the cases came from households with 1 or more additional cases (Table 6). Within the household, 42% of the cases shared a bedroom with at least 1 other individual.

A review of family income for households with cases indicated that 67% of incomes were greater than \$15,000 annually, reflecting the large middle-class population of the community. Only 19% of households with cases reported incomes in the \$5,000 to \$15,000 range. Thirteen cases (8%) came from households with less than \$5,000 annual income.

DISCUSSION

The results indicate that the louse outbreak was well underway before the beginning of school in September, suggesting that the community itself was the main focus of transmission. What role the school played in transmission is difficult to assess. Cases tended to predominate in younger children in the lower grades where interpersonal contacts may be greater. These contacts could occur in after-school activities and during school sessions. At any rate, the grouping of children in schools presents an ideal situation to recognize a pediculosis epidemic.

Table 6. Number of other family members infested with head lice in Ames, Iowa, September to December, 1976.

	No. of Other Family Members Infested						Total
	0	1	2	3	4	5	
Male	29	23	17	8	1	2	80
Female	42	25	16	3	0	0	86
Total	71	48	33	11	1	2	166
Percent	42.8	28.9	19.9	6.6	0.6	1.2	100

Factors that influence transmission have been studied in other outbreaks and relate significantly to grade, bed sharing, socioeconomic status, infestation of other family members, crowding in the home, and family size (Slonka et al., 1976; Slonka et al., 1977). Because non-infested children were not studied, we were unable to adequately evaluate all these factors. Nevertheless, increased involvement in the lower grades was demonstrated. Only 9 cases shared a bed, reflecting a high socioeconomic condition and suggesting that this factor did not play a major role in the outbreak. The large number of cases from families with incomes of more than \$15,000 reflects the profile of this prosperous academic and government agency community. It also underscores that louse infestations are not always associated with poverty or lower socioeconomic families as reported by Slonka et al. (1976, 1977), but may be found among all economic groups (Slonka and McKinley, 1975).

Results suggest that the household itself, in contradistinction to the school environment, probably was a significant site of transmission, as implied in other studies. Multiple cases per household tend to increase with family size and bedroom sharing. The proportion of cases according to hair length and hair color were generally even, suggesting that these factors were not significant, as demonstrated elsewhere. Although female cases outnumber male cases, the difference in attack rates was not significant and perhaps reflects female proclivity for grooming habits, sharing of combs, and other similar activities (Slonka et al., 1976; Slonka et al., 1977).

Control and eradication of the problem was the predominant concern of officials. Responsible media coverage was of great assistance in improving awareness in parents and in detailing the importance of proper treatment and disinfection of clothing and bedding. Citizens were advised that lice were not associated with any particular socioeconomic group and that early recognition and proper treatment were essential to abate the problem.

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