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## Head lice in schoolchildren

*Ye ugle, creepin, blastit wonner,  
Detested, shunned by saunt an' sinner,  
How daur ye set your fit upon her,  
Sae fine a lady.  
Gae somewhere else and seek your dinner  
On some poor body.*

Robert Burns (1759-96, Scotland)

(Written after watching a louse move across a lady's bonnet during the kirk sermon.)

The sentiments expressed by Robert Burns—lice are disgusting, the well-off should be protected from them, and the poor deserve them—are common in Western society. They are enshrined in section 54 of the 1944 Butler Education Act, the most recent statute on the infestation of schoolchildren and still in force. The act implies that lice are caught by wilful negligence, the direct result of low standards of hygiene. It empowers a medical officer 'to ensure cleanliness' if a pupil at a state maintained school is found 'infested with vermin or in a foul condition', thus heightening the stigma attached to catching lice. In ministerial correspondence on child health, no subject features more frequently.<sup>1</sup>

### Biology

The head louse, *Pediculus capitis*, feeds exclusively by sucking blood to which it has ready access on a clean head. It is host specific and an obligate parasite, spending its entire life on human heads. *P. capitis* lays its eggs singly, glued to the hairshaft where the warmth of the scalp will incubate them. The egg is tear shaped and 1 mm long. The louse emerges after seven to 10 days. Eggs and lice are well camouflaged, reflecting the colour of their surroundings. The empty eggshell (nit) turns white and becomes more obvious as the growing hair carries it away from the scalp. Infestation with head lice, pediculosis capitis, is commonly known as 'nits'. Although there can be hundreds of lice on a head, the average is only 10.<sup>2-5</sup> Contrary to expectations, lice may be present on a head for weeks or months without causing the characteristic itch.

The louse passes through three nymphal stages, growing by moulting its skin over 7 to 14 days. The adult louse is 3 mm long. The six legs end in claws used to cling to hairs. Lice cannot jump, but climb speedily from hair to hair. Transmission between hosts is by head to head contact when adult lice move to a new host at every opportunity.

Nymphal stages tend to remain on the head where they hatch.<sup>2</sup> When full grown, lice mate, whereupon the female begins to lay eggs, producing an average of 56 eggs after a single insemination,<sup>6</sup> at the rate of about six per 24 hours.

Hatched lice move swiftly away from any disturbance in dry hair, but if thoroughly wetted, their mobility is much reduced.<sup>7</sup> In 1985 it was shown that fine tooth combing of dripping hair after ordinary shampooing is a simple way to lift out lice.<sup>8</sup> A fine toothed plastic comb is adequate and comfortable.

*P. capitis* is the evolutionary ancestor of *Pediculus humanus*, a second species which presumably appeared after humans began wearing clothes.<sup>9</sup> *P. humanus*, commonly known as the body or clothing louse, lays its eggs glued to cloth fibre and visits the skin to feed. With the development of *P. humanus*, the capacity of lice to spread typhus in infected droppings assumed significance, causing vast numbers of deaths down the centuries. The typhus pathogen, *Rickettsia prowazekii*, can remain infective for seven months, maintained in skin scale protein. It enters the body through skin abrasions and by inhalation. Those who cannot change their clothes, due to poverty or displacement, are vulnerable. European epidemics of typhus threatened during both world wars and it remains endemic in developing countries, and a peril to the refugees of armed conflict.

### Involvement of the school nurse

Methods of mechanical control were advancing before the advent of DDT. In 1920 the Sackers, a family of barbers, developed a fine toothed metal comb capable of removing the eggs and shells. However, it requires a practised worker to perform the process effectively and fairly painlessly. Nurses in cleansing stations continued to use the tool even after the universal introduction of insecticidal shampoos and lotions, to distinguish treated from untreated heads.

School nurses have carried out head inspections in schools since 1890. Mellanby established in 1941 that these inspections usually miss all but the worst cases in school and showed that inspecting schoolchildren without also dealing with their contacts at home, is a self defeating policy.<sup>10</sup> Nevertheless, the significance of this was apparently ignored by many school health services until the 1980s. Up to this time, the public and health professionals were convinced that these inspections were a useful diagnostic procedure.

### Pesticides in UK use

The first modern insecticide, DDT, earned its reputation when an epidemic of typhus in Naples was halted in 1943 by dusting the populace with DDT powder to kill the lice. The hatched stages were poisoned on contact with the pesticide. However, DDT does not kill louse eggs efficiently and successful control depends on introducing the lice to the chemical as they hatch.<sup>11</sup> In spite of this drawback, which creates particular practical problems on the head, it became customary to use DDT against *P capitis* as well as *P humanus* in developed countries. The belief that a pesticide is mandatory for successful treatment became entrenched from this time.

Lindane took its place beside DDT, malathion and carbaryl were launched in the early 1970s, and the pyrethroids, permethrin and phenothrin, followed in 1990. These pesticides are human as well as insect nerve poisons but considered safe for intermittent use. The later pesticides have a relatively better human toxicity profile. All are contact delivered, penetration of the eggshell presenting greater difficulty than the insect cuticle. The quality of clinical trials is often seriously flawed.<sup>12-13</sup> Most are comparisons between two or more active substances.<sup>14-16</sup> The egg killing ability of new compounds is tested on a *P humanus* culture, artificially adapted to feeding on rabbits (the Orlando or Cambridge strain) but the value of this is in question.<sup>5-9</sup> However, for more than a decade after its launch, malathion in a lotion formulation, left on the head for 12 hours, performed well in the field, showing considerable ovicidal activity. In 1983 there was a swing to carbaryl products and a marked rise in reports of hatchlings found on heads in the week after treatment. This indicated that carbaryl does not kill eggs as well as the *in vitro* test results suggested.<sup>15</sup> In 1985 the test design itself was shown to be faulty.<sup>17</sup> Chosidow *et al* conclude that laboratory culture tests are probably not predictive of field results.<sup>5</sup>

### Resistance

Evolution of resistance in a louse population, an inevitable process when pesticides are used over a period of time, is probably accelerated by incomplete egg kill. The Medicines Control Agency, however, does not specifically monitor the continuing susceptibility of head lice to insecticidal treatments once they are licensed. Signs of specific malathion resistance appeared in 1987.<sup>18</sup> Although rotational policies are advocated, there is no evidence that carbaryl resistant lice are susceptible to malathion. This is intrinsically unlikely as they both inhibit the enzyme acetylcholinesterase. Indeed poorly performing carbaryl products may have precipitated full malathion resistance. By 1994 two mechanisms of broad spectrum resistance to malathion and carbaryl were reported in UK head lice.<sup>19</sup> The onset of resistance to the pyrethroids has been rapid, and has been found after only three years' use in Israel.<sup>20</sup> Five years after their UK introduction, Burgess *et al* proposed repeat treatments to overcome pyrethroid resistance.<sup>21</sup>

### Eradication strategy

When malathion first became available, Donaldson envisaged that, with proper use, lice could be eradicated before they had the opportunity to develop resistance, as they had to DDT and lindane.<sup>22</sup> He applied the principles of communicable disease control to pediculosis capitis, thus identifying an essential element for eradication: the coordinated approach. He argued that as the lice that are viable are on people's heads, inspection of all heads at risk and malathion treatment of positive cases, within a short period, would afford the greatest chance of eradication.

Donaldson's approach, submitted to trial in 1972, looked promising<sup>22</sup> but unfortunately, although attempts were made to enlist community involvement, dependence on school nurse checks undermined its success. Because the number of lice in the average infestation is only 10 and lice in dry hair move away from disturbance, school nurse checks produce many false negatives. As Donaldson acknowledged, detecting head lice by visual inspection is difficult.<sup>16</sup> In 1986, he welcomed the discovery that wet combing can detect light cases before the onset of itching.

In 1988 the health charity, Community Hygiene Concern (CHC), was set up to address the head louse problem. It promotes a coordinated approach and wet combing detection techniques, under the name of 'bug busting'. A scheme to send home information via primary schoolchildren and organise a community-wide response on the designated Bug Busting Day, was first piloted with Hounslow District Health Authority and Local Education Authority in 1989 with good results.<sup>19</sup> Every year since, on 31 October, the charity has resourced Bug Busting Day and monitored the effect. From 1992 it has produced a Bug Buster Teaching Pack for schools, piloted in association with the Royal Free Hampstead NHS Trust school health service and Camden Local Education Authority, and subsequently updated as developments required.<sup>23</sup>

### Non-pesticidal treatment

The activity of CHC has taken place against a background of growing dissatisfaction with insecticide treatments. The UK market for louse and scabies products grew by 37% in the period April 1993–March 1995 to over £14 million.<sup>24</sup> There is a feeling of frustration over wasted time and money, and much concern about repeatedly treating children and pregnant mothers with pesticides.<sup>25-27</sup> The CHC Help Line receives up to 80 calls a week from parents describing product failure with all four currently recommended compounds. The charity concurs with Vander Stichele *et al* who are of the opinion that 'The main problem in this therapeutic field, which is riddled with ineffective products...is companies' uncontested marketing of products and their recommendations for treatments, that do not have a solid evidence base'.<sup>28</sup> CHC has sought to develop bug busting into a non-pesticidal treatment and believes on the basis of numerous field observations that it has achieved this.

Further independent evaluation is underway of the claim that tutored use of the 'bug buster' comb in conjunction with ordinary shampoo and conditioner can completely clear head lice. Shampooing soaks the lice, slowing them down, while conditioning makes the hair slippery so they lose their grip, enabling the comb to gently hook them out. Ample conditioning also makes it possible to straighten curly hair with a wide tooth comb, even Afro-Caribbean hair, facilitating insertion of the fine tooth comb. The discovery that it is only necessary to 'bust the bug' at half weekly intervals for a fortnight to clear light or heavy infestations enhanced the practicality of the method. At the first session lice at all stages are removed. The second, third, and fourth sessions clear the hatching nymphs, which take up to 10 days to emerge. The bug busting system exploits our knowledge of the life cycle, removing the hatched lice from the head before they are large enough to spread (at least 6 days old) or reproduce (from 7 days at the earliest). Unless another infestation is acquired in the meanwhile, the patient is left with harmless, empty egg cases on the hair and will not pass on lice between sessions. With adequate instruction, the method is easily within the grasp of most parents. It is fully explained in the Bug Buster Kit for family use, piloted in 1995.

## Conclusion

There are several essential elements in a successful eradication strategy. The most important are a means of detecting cases with low levels of infestation, a coordinated approach to ensure that symptomatic and asymptomatic cases are identified simultaneously, and safe, effective treatment.

Legislation does not require a pesticide to be used in the treatment of any personal parasite and there is no reason why health workers should not use bug busting for patients with head lice. Parents like the method and because of worries about the potential risk of toxicity from pesticide exposure,<sup>27</sup> are glad to avoid their use. Health authorities are finding it cost effective to supply teaching materials produced by CHC in a whole school approach that introduces parents to the method.<sup>29</sup> Most children find bug busting a pleasant experience compared with conventional treatment, and take a keen interest in observing the size of the lice to measure progress! Participation removes the stigma attached to lice as the pupils cheerfully compose new lousy lyrics to the tune of Ghost Busters:

*When there's something strange in your hair  
Who're you goin' to call?  
Bug Busters!*

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