Head lice infestation: bug busting vs. traditional treatment

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Summary

• The two main methods of managing head lice infestation in the UK are head lice lotions and bug busting; there is no conclusive evidence as to which of these methods is most effective.

• The aim of this study was to compare the effectiveness of the bug busting method with lotion.

• A pilot study in the form of a randomized controlled trial involving two semi-rural general practices was used. Thirty children aged 4–16 years were randomly assigned to two intervention groups.

• After initial dry combing to detect the presence of head lice, one group was treated with phenothrin lotion. The bug busting group received combing using special combs provided in the bug busting pack and hair conditioner.

• The main outcome measure was the number of adult live lice and nymphs at day 14.
• On day 14 in the bug busting group, total eradication of head lice had occurred in eight children; in the lotion group, total eradication had occurred in two children ($P = 0.052$); number needed to treat 2.5 (95% CI: 2.19–2.81).

• These results suggest that bug busting performed by nurses in a controlled situation is an effective method of managing head lice infestation.

**Keywords:** bug busting, head lice, pediculocides, phenothrin, primary care, randomised controlled trial.

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**Introduction**

Head lice (*Pediculus capitis*) are one of the most common forms of human ectoparasites (Vander Stichte et al., 1995). Although infection is neither life-threatening nor associated with significant complications, it does cause considerable distress, expense and anxiety to sufferers (Keeley, 1997).

Lice are wingless, six-legged insects that cannot jump, fly or swim. The life cycle of the head louse from egg to egg is about 25–26 days. A mature adult female louse lays four to five eggs a day over her lifetime of 23–30 days (Lane, 1987). The egg case commonly referred to as a ‘nit’ is attached firmly to the hair shaft with a cement-like biological glue, thus providing a protective environment for the developing louse (nymph). After a 7–10 day incubation period, the nymph hatches and then proceeds through three additional instar nymph stages of 3–4 days each. The adult can start laying eggs from about 2 days after the final moult (PHLS, 1997).

The prevalence of head lice remains high and epidemics occur regularly despite all efforts at control (Mumcuoglu et al., 1990. Anonymous, 1997). Between 1987 and 1998, published figures report a percentage infestation among English school children inspected of around 2% (Mumcuoglu et al., 1990). These figures should, however, be interpreted with caution because all UK health authorities have abandoned routine inspections of children’s heads and therefore can only provide an estimate of the number of cases. Reports suggest that no subject features more frequently in ministerial correspondence on child health than the prevention and treatment of the head louse (Department of Health, 1995). It was anticipated that, with the introduction of new insecticides and more efficient formulations for treating head lice, the prevalence would be greatly reduced by the end of the 20th century. However, despite the numerous treatments available, prevalence remains high and epidemics occur regularly (Lindsay & Peck, 1993). Over-the-counter purchases of products for the treatment of head lice and scabies in the UK grew by 43% between 1993 and 1995. The market at the time was worth £14.4 million at retail (inclusive of prescription sales), having increased 37% in sterling terms over the 2-year period (Anon, 1995). Approximately 3 million treatment units for lice and scabies are supplied annually in the UK (Burgess, 1996).

Under sections 521–5 of the United Kingdom Education Act 1996, the school nurse may police re-entry of children into school following exclusion for head lice infestation. However, because school nurses are now employed by Health Authorities rather than Local Authorities, their role has changed to one of screening, parental counselling and education. Mass head inspections were phased out permanently in the 1980s but the head lice problem remains.

Parents of young children are increasingly concerned about the effects of repeatedly applying chemicals to their children’s heads (Sutkowski, 1989; Rodgers & Ellefson, 1992; Swadener, 1992). These concerns have led to a growth in interest in managing head lice infestation using alternative methods. A recent Cochrane review of interventions for treating head lice called for trials of the bug busting method, because there had been no previous work in this area (Dodd, 2000).

Roberts et al. compared the use of malathion with the wet-combing method (Roberts et al., 2000) and demonstrated the effectiveness of parents carrying out the treatment. Therefore we designed a study to test the effectiveness of the actual method, using trained nurses to carry out the procedure in controlled conditions.

**Methods**

**STUDY POPULATION**

The two local primary schools, all local pharmacists and two general practices were informed of the study. Posters were placed throughout the locality to invite any parents of children with a suspected head lice infestation to participate. The inclusion criteria were that all children were aged 4–16 years, with head lice infestation, i.e. the presence of live (moving) lice, attending the two

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The exclusion criteria were as follows: children with active symptomatic asthma; persistent skin disorder of the scalp; treatment with other head lice products within the previous 4-week period; hair that had been bleached, permed or coloured within the previous 4-week period; and a known sensitivity to pyrethroid, organophosphate and/or carbonate insecticides and/or sensitivity to chrysanthemums.

Parents and siblings of all children were assessed to determine head lice infestation. If head lice infestation was found to be present they were also treated. No data from infested parents were included in the data analysis.

ETHICAL APPROVAL

The Local Research Ethics Committee granted approval for the study. Written informed consent was obtained from the parent/guardian of all children participating in the trial.

INTERVENTIONS

Two interventions were used in this study: bug busting (intervention) and application of lotion-phenothrin (control). Trained nurses following a standard protocol carried out both interventions. Initially children were seen in the surgery or at home to determine head lice infestation. Baseline data on age, sex, length of hair and number of family members infested were recorded (see Table 1). The exclusion criteria were checked, including presence of asthma and scalp disorders. Parents were then requested to give written informed consent for their child to participate in the trial.

The bug busting pack consists of five combs, the width between the teeth of the comb of varying specificity, a plastic cape, an instruction leaflet for use and information leaflets for both children and parents. Parents are advised to comb through the child’s hair with the widest toothed comb first and then to apply conditioner to the child’s hair. They are then advised to comb through the child’s hair, removing any lice and ‘nits’ as they do so. They are advised to continue this with the finest toothed comb until no further lice or nits can be found. They are then to repeat the process every third day for a 14-day period.

In this study, at the first contact all children had their hair combed with the large (yellow) head lice comb from the bug busting pack for diagnostic purposes. All head lice found were taped with clear adhesive tape to a patient case report form. The child then chose a sealed opaque envelope containing a card marked with a letter A or B (A = lotion, B = bug busting pack). The child was then allocated to the chosen group.

Children in the lotion group had their hair combed dry by a nurse, using the large (yellow) head lice comb supplied with the bug busting pack. Lotion (phenothrin) was then applied to their hair and parents were asked to wash it after a minimum of 2 h and then to comb through again using the same comb.

The lotion group returned on the 7th day, and again their hair was combed dry. Any lice found were taped to the child’s case report form for analysis. Lotion was then applied for the second time and the parents were asked to wash the hair after a minimum of 2 h and then to comb through again, using the same comb.

In the bug busting group, the child’s hair was initially combed dry by a nurse, using the large yellow head lice comb supplied with the bug busting pack, for diagnostic purposes. Hair conditioner (Unichem own brand) was then applied and the nurse combed through the hair using the different graded combs in the bug busting pack as recommended until no further lice or eggs could be removed. Once this was done the nurse combed through the hair again using the various combs in the bug busting pack to ensure total eradication.

Children in the bug busting group were seen again on the 4th, 7th, and 10th day. Each time the hair was combed dry, removing any head lice and eggs. These were taped onto the child’s case report form on the 1st, 7th and 14th days for analysis. Conditioner was then applied and the hair combed using the bug busting pack until no further lice could be found.

On day 14 all children were seen again. Any head lice found on their hair (using the large yellow head lice comb

Table 1 Baseline characteristics of randomized population

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Treatment group (BBP)</th>
<th>Control group (lotion)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age</td>
<td>8.1, SD 2.56</td>
<td>9.27, SD 3.95</td>
</tr>
<tr>
<td>Male</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Female</td>
<td>11</td>
<td>12</td>
</tr>
<tr>
<td>No. of ‘only’ children in same household</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>No. with infested siblings</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>No. with non-infested siblings</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>Hair length short</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Hair length to collar</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Hair length below collar</td>
<td>9</td>
<td>6</td>
</tr>
</tbody>
</table>

BBP: bug busting pack.

supplied with the bug busting pack) were taped to the child's case report form for analysis. If any child was still found to have head lice, they continued to be treated using the bug busting pack until all these were eradicated. These data were not included in the trial. Those children who used lotion were offered the choice of a different lotion or the bug busting procedure. Because others could not use the bug busting pack combs, they were given to all participating children at the end of the trial. There were no adverse reactions reported throughout the study period.

OUTCOME MEASURES

The main outcome measure was the absence of live lice on the last (14th) day of the trial period.

STATISTICAL ANALYSIS

Intention to treat analysis was conducted using Mann Whitney U-tests for continuous data; \( \chi^2 \)-tests were used for categorical data.

Results

MAIN OUTCOME

Of 36 children eligible, six declined to take part, leaving 30 to be randomized. As Fig. 1 shows, there were no dropouts or losses to follow-up and all children completed the trial. No significant differences in children's characteristics were found between the lotion and the bug busting groups at baseline (Table 1). Children in the

Figure 1 Consort diagram.
lotion group were a year older on average, but this difference was not statistically significant. Both groups contained similar proportions of sexes, hair length and siblings infested with head lice.

The distributions of numbers of head lice infesting children in the two groups were heavily positively skewed and so comparisons were made using non-parametric statistics. On day 1, children in the bug busting group were infested with a median of eight lice at any stage in development; a median of eight nymphs and one adult. This compared with medians of seven nymphs, one adult and 10 lice at any developmental stage in the lotion group. This difference was not statistically significant.

At day 7 there were significant differences in the numbers of nymphs ($P = 0.045$) and adults ($P = 0.017$) between the two groups, the bug busting group having a median of three nymphs, 0 adults and three head lice at any stage of development. This compared with medians of 12, two and 15, respectively, in the lotion group. This pattern was also observed at day 14 (for nymphs $P = 0.031$ and for adults $P = 0.023$). Here, the bug busting group had a median of 0 nymphs, 0 adults and no head lice at any stage of development. This compared with medians of two, one and five, respectively, in the lotion group.

Whereas in the lotion group the total number of living head lice found on days 1, 7 and 14 was 1028, the total in the bug busting group on these days was 466. This could be explained by the fact that the majority of head lice in the latter group had been removed as part of the intervention. At day 7 in the lotion group, the number of living nymphs was 462 (45% of the total), compared with 218 (47%) in the bug busting group (not significant). However, at day 14 in the lotion group, the number of living nymphs was 280 (27% of the total) compared with only 29 (6%) in the bug busting group ($P < 0.001$). By day 14, total eradication of head lice had occurred in two children in the lotion group and eight in the bug busting group ($P = 0.0502$). This gives a number needed to treat of 2.5 (95% CI: 1.51–16.75). This means that 2.5 children need to be treated with the bug busting method, who would have otherwise received lotion, to clear 1 child of head lice.

Discussion

The study findings showed that bug busting was an effective method of managing head lice infestation. We could find no other evidence to demonstrate that bug busting performed under controlled conditions by nurses is as effective as head lice lotion.

This study was designed to test the effectiveness of the method of managing head lice infestation and not the ability of parents. Participants were a random sample of the local population of children found to have head lice. Participants were not paid to participate in the trial so as not to provide a false incentive; however, the bug busting packs were given to the children on completion of the trial. They were not aware that this was to happen until the trial was over. All members of each household were screened by combing at the initial and each follow-up contact so as to avoid the possibility of re-infestation.

In a pragmatic study comparing bug busting with malathion treatment for head lice infestation, Roberts found that malathion was twice as effective as bug busting (Roberts et al., 2000). However, methodological problems existed with this trial, as discussed earlier: 50% of the participants overall did not comply with treatment and, of these, 86% deviated by extending or shortening recommended treatment intervals by 1–3 days. The difference with our study is that bug busting was carried out as recommended every 3rd day for a 2-week period. This suggests the crucial nature of carrying out bug busting as recommended and thus not allowing the immature louse to mature and go on to reproduce.

The sample size of our study was small; however, the study was conducted primarily to pilot the feasibility of a larger study. In spite of the small sample size we can demonstrate the effectiveness of the bug busting method. The cumulative head lice count increased on day 7 in the lotion group, indicating that only adult lice were being eradicated by lotion. This is important when considering the clinical management of head lice infestation, because it indicates the need to supply enough lotion for two applications (i.e. 100 ml per child) 7 days apart to ensure eradication of emerging nymphs. The cumulative head lice count in the bug busting group had decreased significantly by day 7, indicating that the combing method was successful in eradicating both adult lice and emerging nymphs. At day 7, of the total number of lice detected in each intervention group, a similar percentage of lice were detected in both groups (45% in the lotion group and 47% in the bug busting group).

By day 14 the percentage had fallen to 6% in the bug busting group but had remained at 22% for the lotion group. This further indicates that the bug busting method was successful in eradicating lice at all stages of their life cycle. Total eradication of lice in the lotion group had only occurred in two children, whereas eight children in the bug busting group had been completely eradicated of head lice ($P = 0.0502$).
There has been considerable debate on the efficacy of traditional head lice lotions. Chosidow et al. suggest that children in France have acquired resistance to d-phe-nothrin and that malathion is more effective (Chosidow et al., 1994). However, in a systematic review of the clinical efficacy of topical treatments for head lice, it is suggested that permethrin is the only effective treatment (Vander Stichele et al., 1995). In our study, phenothrin was chosen for pragmatic reasons in that children were reluctant to attend school if their hair smelt strongly of chemical preparations and phenothrin was the most pleasant smelling. This may be considered as a limitation of our study but, more importantly, the compliance component demonstrated by Roberts et al. (2000) is a key factor in managing head lice infestation. Local resistance to phenothrin is unknown, and the head lice removed have been sent for resistance testing.

All the children co-operated willingly with the study, the majority enthusiastically. This reflects similar experiences in other studies (Ibarra, 1995). The stigma of head lice was of more concern to parents than children. The majority of the children were recruited between May and July 1999 and then again between September and November 1999. This reflects school term times and the increased incidence of head lice infestation, possibly due to close contact with other children.

Three times more girls than boys participated in the trial, reflecting the higher prevalence of head lice in girls (Downs et al., 1999). Because it is not possible to blind participants to treatment allocation, children were allowed to choose their own allocation envelope. The trial group code was written on paper and placed in an opaque sealed envelope and the child then chose an envelope at random. It was not possible to blind the researcher to the trial group of the child because the children openly discussed their role in the trial. However, the final analysis was carried out blindly, with individual case report forms coded so that the researcher counting the number of lice detected was unaware of which group the child was in. As the trial progressed it became obvious that treatment at home was the preferred environment for all participants: children, parents and nurse researchers. This allowed for more flexible arrangements and enabled children to be seen in the privacy of their own homes and after school, although it did mean that nurses would often treat children in the early evening (around their social calendar).

Combing lasted between 20 and 45 min (average duration 30 min) for each child, depending on the length and thickness of the hair. The lice retained were only those combed out for evaluation, i.e. at initial combing on day 1, and on the 7th and 14th days. Lice combed out using a conditioner were thrown away with the conditioner. The conditioner used was Unichem own brand and the same conditioner was used for every child. The average head lice infestation consisted of approximately 10 lice. This is consistent with other studies (Ibarra, 1991; Chosidow et al., 1994).

In spite of the length of time it takes to undertake the bug busting method, children who participated in this study have continued to bug-bust routinely on a weekly basis and have remained free of infestation, suggesting that routine combing can be preventative. Roberts et al. (2000) state that the bug busting method requires a significant investment of time and effort for it to work. Their compliance rate was only 50% overall and there was no significant difference between the two treatment groups with regard to compliance. This suggests that the investment of time and effort played little part in their reason for compliance; regardless of whether the treatment method was lotion (considered easier to apply) or bug busting (considered time consuming and a tedious process), the level of compliance was similar. Secondly, their mean duration of treatment was 17.7 days, with some continuing treatment for longer than 27 days; our study measured success at 14 days.

Our trial followed the instructions for bug busting, i.e. to comb through the hair every third day for a 14-day period. Analysis was then carried out and eight children in the bug busting group were totally eradicated of head lice. However, we continued to bug bust the other children every 3rd day until all head lice had been eradicated and by day 24 this had been achieved. Had we used these data for analysis then we would have had 100% eradication of head lice in the bug busting group, thus giving very different results.

The bug busting method has been criticized because 'too few people have sufficient motivation or skill' to implement the method effectively and success is most likely if an infestation is found in the earliest stages when few lice are present (Burgess, 1997). Our study gives parents evidence that the bug busting pack is effective, which may in turn increase motivation. If parents are advised and encouraged to use the bug busting method on a weekly basis to detect head lice infestation, our results suggest that future re-infestation could be eradicated in its early stages. In developed countries, over-the-counter pediculocides are expensive, which may cause difficulty for some low income groups. This study provides evidence that bug busting is an effective alternative method.

Our trial met all three of the inclusion criteria for randomized controlled trials indicated in the Cochrane
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Review. These are as follows: firstly, participants should have live lice or lice and eggs present; secondly, participants should not have used any other pediculicide in the month preceding enrolment; and finally, lice and eggs should not be removed by combing following treatment with a pediculicide, except during detection combing.

There are two possible limitations with this study. Firstly, none of the participants were followed-up 24 h after the first treatment; therefore re-infestation could have occurred before the 7th day, when detection combing and removal of lice for analysis was carried out. Second, there has been evidence of resistance developing to phenothrin within 2.5 years in Israel (Mumcuoglu et al., 1995) and 4 years in the UK (Burgess et al., 1995), but not so quickly in France (Chosidow et al., 1994). However, there is evidence of some degree of resistance to all head lice lotions and this does not detract from the study findings that bug busting is an effective method of managing head lice infestation. It does indicate, however, that further studies should be carried out using other pediculicides in comparison with the bug busting method.

There is the potential to make cost savings by recommendation of the bug busting method. The total cost for prescribing traditional head lice lotions, i.e. malathion, permethrin, phenothrin and carbaryl, across the locality’s Primary Care Group for the 6-month data collection period was £10 720.98. The cost to the two general practices participating in the study totalled £506.18 for head lice lotion. The cost for a bug busting pack (which is not available on prescription from the NHS) to the parent is £4.95 and the cost of one treatment of traditional head lice lotion (phenothrin, 200 ml) is £8.99 (the prescription cost is £4.62 to the GP budget).

Consideration should also be given to the time taken to comb out the child’s hair. However, it was not the intention of this study to make a full cost analysis and prescribing analysis cost data (Prescription Pricing Authority, 1999) do not differentiate between prescriptions for head lice or scabies, so that data for such a comparison are not at present available.

Conclusions

The results of this study suggest that bug busting is an effective alternative to the use of traditional head lice lotion (phenothrin) in managing head lice infestation. Bug busting does require a commitment from the family of approximately 30–45 min per child per week and strict adherence to the recommended combing guidelines is crucial to success. The message to all members of the primary health care team is to inform parents of the effectiveness of the bug busting method and to educate them on adherence to treatment guidelines.

There remain conflicting opinions as to the most appropriate method of managing *Pediculus capitis*. However, this study provides professionals with evidence that bug busting is as effective as head lice lotion.

Acknowledgments

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References

& East Devon. Prescription Pricing Authority, Newcastle Upon Tyne.

The number needed to treat (NNT) is a way of reporting the results of a randomized controlled trial for which the outcome measure is binary, that is, survive/die or success/failure. In such a trial, comparing a new treatment with a standard treatment, then the number needed to treat is the number of patients we would need to treat with the new treatment to achieve one more success than we would get by treating them with the standard treatment. Cook & Sackett (1995) argue that NNT is clinically easier to interpret than relative risk, odds ratio or risk reduction – the other measures commonly used to report the results of such trials. NNT has become widely used, particularly in the context of clinical trials and systematic reviews.

NNT is calculated as the reciprocal of the difference between the proportion of success on the new treatment and the proportion of success on the old treatment. For example, in Plastow et al. (2001) the proportion of children successfully treated (total eradication by day 14) with bug busting (new treatment) is 0.533 and with lotion (standard treatment) is 0.133, so the NNT is \( \frac{1}{0.533 - 0.133} = \frac{1}{0.4} = 2.5 \). That is, for every 2.5 children treated with bug busting rather than lotion we will have one more successful outcome than if the children had been treated with lotion.

As Bland (2000) explains, the smaller the NNT the better the new treatment is in comparison to the standard. The smallest possible value for NNT is 1.0, which would only occur if the new treatment was always successful and the standard treatment was never successful. The NNT cannot be zero, but it can be negative which would indicate that the new treatment is harmful and less successful than the standard treatment. In such a case the number may be called the number needed to harm (NNH). If the new treatment and the standard treatment are equally effective then the NNT will be infinite.

As with any estimate of treatment effect, it is better to present a confidence interval rather than a single value point estimate. Altman (1998) discusses how to calculate and interpret the confidence interval for NNT. This is straightforward for the situation in which the new treatment is significantly better than the standard treatment. However, for the situation in which the two treatments are not significantly different the confidence interval will have two parts. As Bland (2000) comments, this is not exactly intuitive and he provides examples to illustrate the difficulty of interpreting such intervals.

Further reading


