ClinicalEvidence

Head lice

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ABSTRACT

INTRODUCTION: Head lice can only be diagnosed by finding live lice, as eggs take 7 days to hatch and may appear viable for weeks after death of the egg. Infestation may be more likely in school children, with risks increased in children with more siblings, longer hair, and of lower socioeconomic group. METHODS AND OUTCOMES: We conducted a systematic review and aimed to answer the following clinical question: What are the effects of treatments for head lice? We searched: Medline, Embase, The Cochrane Library, and other important databases up to June 2010 (Clinical Evidence reviews are updated periodically, please check our website for the most up-to-date version of this review). We included harms alerts from relevant organisations such as the US Food and Drug Administration (FDA) and the UK Medicines and Healthcare products Regulatory Agency (MHRA). RESULTS: We found 26 systematic reviews, RCTs, or observational studies that met our inclusion criteria. We performed a GRADE evaluation of the quality of evidence for interventions. CONCLUSIONS: In this systematic review, we present information relating to the effectiveness and safety of the following interventions: benzyl alcohol, dimeticone, herbal and essential oils, insecticide combinations, isopropyl myristate, ivermectin, lindane, malathion, mechanical removal by combing ("bug busting"), oral trimethoprim–sulfamethoxazole (co-trimoxazole, TMP-SMX), permethrin, phenothrin, pyrethrum, and spinosad.

QUESTIONS

INTERVENTIONS

TREATMENT

Key points

- Head lice can only be diagnosed by finding live lice, as eggs take 7 days to hatch, and may appear viable for weeks after death of the egg.

  Infestation may be more likely in school children, with risks increased in children with more siblings, longer hair, or of lower socioeconomic group.

- Malathion lotion may increase lice eradication compared with placebo, phenothrin, or permethrin. Current best practice is to treat with two applications 7 days apart, and to check for cure at 14 days.

  Studies comparing malathion or permethrin with wet combing have given conflicting results, possibly because of varying insecticide resistance.

  Oral ivermectin may be more effective at eradicating head lice than malathion in people with previous failed treatment with insecticides.

  However, although tested in a clinical trial, oral ivermectin is not currently licensed for treating head lice, and generally its likely usefulness has been superseded by the introduction of physically acting chemicals that are not affected by resistance and which are generally considered safer.

- Permethrin may be more effective at eradicating lice compared with placebo or lindane.

  Eradication may be increased by adding trimethoprim–sulfamethoxazole (TMP-SMX, co-trimoxazole) to topical permethrin, although this increases adverse effects.

- We don't know whether combinations of insecticides are beneficial compared with single agents or other treatments.

- Dimeticone may be more effective at eradicating lice compared with malathion or permethrin.

  Dimeticone and phenothrin have produced similar results, but this may be because of varying insecticide resistance and the formulation of phenothrin used.

- We don't know whether pyrethrum is beneficial compared with other insecticides.
- CAUTION: Lindane has been associated with central nervous system toxicity.
- Some herbal and essential oils may be beneficial to eradicate lice compared with other treatments but this is likely to depend upon the compound(s) or extracts used.
- Isopropyl myristate may be more effective at eradicating lice than permethrin.
- Benzyl alcohol may be more effective at eradicating lice than placebo. However, we don't know whether benzyl alcohol is more effective than insecticides or other treatments used in routine clinical practice.
- Spinosad may be more effective at eliminating lice than permethrin.

DEFINITION

Head lice are obligate ectoparasites of socially active humans. They infest the scalp and attach their eggs to the hair shafts. Itching, resulting from multiple bites, is not diagnostic, but may increase the index of suspicion. Eggs glued to hairs, whether hatched (nits) or unhatched, are not proof of active infection, because eggs may retain a viable appearance for weeks after death. A conclusive diagnosis can only be made by finding live lice. One observational study compared two groups of children with louse eggs but no lice at initial assessment. [1] Over 14 days, more children with 5 or more eggs within 6 mm of the scalp developed infestations compared with those with fewer than 5 eggs. Adequate follow-up examinations using detection combing are more likely to be productive than nit removal to prevent re-infestation. Infestations are not self-limiting.

INCIDENCE/ PREVALENCE

We found no studies on incidence and few recently published studies of prevalence in resource-rich countries. Anecdotal reports suggest that prevalence has increased since the early-1990s in most communities in Europe, the Americas, and Australasia. A cross-sectional study from Belgium (6169 children aged 2.5–12.0 years) found a prevalence of 8.9%. [2] An earlier pilot study (677 children aged 3–11 years) showed that in individual schools the prevalence was as high as 19.5%. [3] One cross-sectional study from Belgium found that head lice were significantly more common in children from families with lower socioeconomic status (OR 1.25, 95% CI 1.04 to 1.47), in children with more siblings (OR 1.2, 95% CI 1.1 to 1.3), and in children with longer hair (OR 1.20, 95% CI 1.02 to 1.43), although hair length may primarily influence the ability to detect infestation. The socioeconomic status of the family was also a significant influence on the ability to treat infestations successfully — the lower the socioeconomic status, the greater the risk of treatment failure (OR 1.70, 95% CI 1.05 to 2.70). [2]

AETIOLOGY/ RISK FACTORS

Observational studies indicate that infestations occur most frequently in school children, although there is no evidence of a link with school attendance. [4] [5] We found no evidence that lice prefer clean hair to dirty hair.

PROGNOSIS

The infestation is almost harmless. Sensitisation reactions to louse saliva and faeces may result in localised irritation and erythema. Secondary infection of scratches may occur. Lice have been identified as primary mechanical vectors of scalp pyoderma caused by streptococci and staphylococci usually found on the skin. [6]

AIMS OF INTERVENTION

To eliminate infestation by killing or removing all head lice and their eggs.

OUTCOMES

Eradication rate: Treatment success is given as the percentage of people completely cleared of head lice. **Adverse effects.** There are no standard criteria for judging treatment success or what constitutes infestation. Trials used different methods, and in many cases the method was not reported. Few studies were pragmatic.

METHODS

Clinical Evidence search and appraisal June 2010. The following databases were used to identify studies for this systematic review: Medline 1966 to May 2010, Embase 1980 to May 2010, and The Cochrane Database of Systematic Reviews 2010, Issue 2 (1966 to April 2010). An additional search within The Cochrane Library was carried out for the Database of Abstracts of Reviews of Effects (DARE) and Health Technology Assessment (HTA). We also searched for retractions of studies included in the review. Abstracts of the studies retrieved from the initial search were assessed by an information specialist. Selected studies were then sent to the contributor for additional assessment, using predetermined criteria to identify relevant studies. Study design criteria for inclusion in this review were: published systematic reviews of RCTs and RCTs in any language, at least single blinded, and containing >20 individuals of whom >80% were followed up. There was no minimum length of follow-up required to include studies. We excluded all studies described as "open", "open label", or not blinded unless blinding was impossible. The initial search was performed by the Cochrane Infectious Diseases Group at the Liverpool School of Tropical Medicine for a systematic review compiled in July 1998 (now withdrawn). [7] We searched for each intervention versus placebo or versus each other, and reported any studies of sufficient quality that we found.

We included systematic reviews of RCTs and RCTs where harms of an included intervention were studied applying the same study design criteria for inclusion as we did for benefits. In addition we use a regular surveillance protocol to capture harms alerts from organisations such as the FDA and the MHRA, which are added to the reviews as required. To aid readability of the numerical data in our reviews, we round many percentages to the nearest whole number. Readers should be aware of this when relating percentages to summary statistics such as relative risks (RRs) and odds ratios (ORs). We have performed a GRADE evaluation of the quality of evidence for interventions included in this review (see table, p 39). The categorisation of the quality of the evidence (high, moderate, low, or very low) reflects the quality of evidence available for our chosen outcomes in our defined populations of interest. These categorisations are not necessarily a reflection of the overall methodological quality of any individual study, because the Clinical Evidence population and outcome of choice may represent only a small subset of the total outcomes reported, and population included, in any individual trial. For further details of how we perform the GRADE evaluation and the scoring system we use, please see our website (www.clinicalevidence.com).

QUESTION What are the effects of treatments for head lice?

OPTION MALATHION

- For GRADE evaluation of interventions for Head lice, see table, p 39 .
- Malathion lotion may increase lice eradication compared with placebo, phenothrin, or permethrin. Current best practice is to treat with two applications 7 days apart, and to check for cure at 14 days.
- Trials comparing malathion with wet combing have given conflicting results, possibly because of varying insecticide resistance.
- We found no clinically important results from RCTs about the effects of malathion compared with herbal treatments, pyrethrum, lindane, trimethoprim–sulfamethoxazole (TMP-SMX, co-trimoxazole), isopropyl myristate, benzyl alcohol, or spinosad.

Benefits and harms

Malathion versus placebo:

We found no systematic review but found one RCT. [8] The RCT (119 children and adults) compared malathion 0.5% alcoholic lotion (applied for 12 hours) versus malathion 0.5% alcoholic lotion vehicle.

Eradication rate

Compared with placebo Malathion may be more effective at increasing head lice eradication rates at 7 days (low-quality evidence).

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Eradication rate					
[8] RCT	119 children and adults	**Proportion head-lice free , 1 day** 68/68 (100%) with malathion (0.5% alcoholic lotion) 42/47 (89%) with placebo (0.5% malathion lotion vehicle)	P <0.01 See further information on studies	○○○	malathion
[8] RCT	119 children and adults	**Proportion head-lice free , 7 days** 62/65 (95%) with malathion (0.5% alcoholic lotion) 21/47 (45%) with placebo (malathion lotion vehicle)	P <0.001 See further information on studies	○○○	malathion

Adverse effects

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Adverse effects					
[8] RCT	119 children and adults	**Sensation of scalp burning** 1 person with malathion 0 people with placebo	Significance not reported See further information on studies		

Malathion versus phenothrin:

We found no systematic review but found one RCT. [9] The RCT (193 school children) compared malathion 0.5% alcoholic lotion (applied for 8 hours or overnight) versus d-phenothrin 0.3% lotion.

Eradication rate

Compared with phenothrin Malathion may be more effective at increasing head lice eradication rates (low-quality evidence).

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Eradication rate					
[9] RCT	193 school children	**Proportion of louse-free children , 1 day** 87/95 (92%) with malathion (0.5% alcoholic lotion) 39/98 (40%) with phenothrin (0.3% lotion)	RR 2.3 95% CI 1.7 to 2.9	●●○	malathion
[9] RCT	193 school children	**Proportion of louse-free children , 7 days** 90/95 (95%) with malathion 38/98 (39%) with phenothrin	RR 2.4 95% CI 1.8 to 3.2	●●○	malathion

Adverse effects

No data from the following reference on this outcome. [9]

Malathion versus permethrin:

We found no systematic review but we found two RCTs. [10] [11] One RCT compared malathion 0.5% alcoholic lotion (applied for 20 minutes) versus permethrin 1% creme rinse (applied for 10 minutes). [10] Both products were applied once, with a second application after 7 days if lice were found. The other RCT compared 5 treatment regimens: malathion 0.5% alcoholic lotion applied for 8 to 12 hours, malathion 0.5% gel applied for 30 minutes, malathion 0.5% gel applied for 60 minutes, malathion 0.5% gel applied for 90 minutes, and permethrin 1% creme rinse applied for 10 minutes. [11] Each of the products was applied once, with a second application after 7 days if lice were found. Treatments were randomised in a 3:3:3:3:1 ratio with permethrin in the smaller group (see further information on studies).

Eradication rate

Compared with permethrin Malathion may be more effective at eradicating head lice at 14 days, but not at 7 days (low-quality evidence).

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Eradication rate					
[10] RCT	66 school children and adults	**Proportion of louse-free people , 7 days** 33/41 (80%) with malathion 0.5% alcoholic lotion left on for 20 minutes 13/22 (59%) with permethrin 1% creme rinse left on for 10 minutes	P = 0.08	⟷	Not significant
[10] RCT	66 school children and adults	**Proportion of louse-free people , 14 days** 40/41 (98%) with malathion 0.5% alcoholic lotion left on for 20 minutes 12/22 (55%) with permethrin 1% creme rinse left on for 10 minutes	P <0.0001	○○○	malathion
[11] RCT **5-armed trial**	172 school children and adults The third arm evaluated malathion 0.5% topical gel applied for 30 minutes The fourth arm evaluated malathion 0.5% topical gel applied for 60 minutes The fifth arm evaluated malathion 0.5% topical gel applied for 90 minutes	**Proportion of louse-free people , 14 days** 29/30 (97%) with malathion 0.5% alcoholic lotion applied for 8 to 12 hours 5/11 (45%) with permethrin 1% creme rinse applied for 10 minutes	P = 0.0006	○○○	malathion
[11] RCT **5-armed trial**	172 school children and adults The third arm evaluated malathion 0.5% topical gel applied for 60 minutes The fourth arm evaluated malathion 0.5% topical gel applied for 90 minutes The fifth arm evaluated malathion 0.5% topical lotion applied for 8 to 12 hours	**Proportion of louse free people , 14 days** 52/53 (98%) with malathion 0.5% gel applied for 30 minutes 5/11 (45%) with permethrin 1% creme applied for 10 minutes	P <0.0001	○○○	malathion
[11] RCT **5-armed trial**	172 school children and adults The third arm evaluated malathion 0.5% topical gel applied for 90 minutes The fourth arm evaluated malathion 0.5% topical lotion applied for 8 to 12 hours	**Proportion of louse-free people , 14 days** 38/41 (93%) with malathion 0.5% gel applied for 60 minutes 5/11 (45%) with permethrin 1% creme applied for 10 minutes	P = 0.001	○○○	malathion

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
	The fifth arm evaluated malathion 0.5% topical gel applied for 30 minutes				
[11] RCT **5-armed trial**	172 children and adults The third arm evaluated malathion 0.5% topical lotion applied for 8 to 12 hours The fourth arm evaluated malathion 0.5% topical gel applied for 30 minutes The fifth arm evaluated malathion 0.5% topical gel applied for 60 minutes	**Proportion of louse-free people , 14 days** 32/37 (86%) with malathion 0.5% gel applied for 90 minutes 5/11 (45%) with permethrin 1% creme applied for 10 minutes	P = 0.01	○○○	malathion

Adverse effects

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Adverse effects					
[10] RCT	66 children and adults	**Adverse effects** with malathion with permethrin No adverse effects were reported with permethrin. One person complained of scalp burning with malathion and the product was washed off early. For full details, see further information on studies			
[11] RCT **5-armed trial**	172 children and adults	**Treatment-related adverse effects** 4 adverse effects (3 erythema with burning sensation, 1 excoriation) reported with malathion lotion 7 adverse effects (4 headaches, 1 nausea, 1 vomiting, 1 dizziness) reported with malathion gel, all durations combined 1 adverse effect (seborrhoeic dermatitis) reported with permethrin	Reported as no significant difference between treatment groups P value not reported	⟷	Not significant

Malathion versus mechanical removal of lice:

We found no systematic review but found one RCT comparing "bug busting" (wet combing with conditioner) versus two applications of malathion 0.5% (27 people given alcoholic lotion, 13 people given aqueous liquid each applied for 8 hours or overnight) 7 days apart. [12]

Eradication rate

Compared with mechanical removal ("bug busting") Malathion seems to be more effective at increasing eradication of head lice at 14 days (high-quality evidence).

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Eradication rate					
[12] RCT	72 school children	**Proportion of lice-free children, 14 days** 31/40 (78%) with malathion 12/32 (38%) with "bug busting"	RR 2.07 95% CI 1.30 to 3.30	●●○	malathion

Adverse effects

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Adverse effects					
[12] RCT	72 school children	**Adverse effects** with malathion with "bug-busting" One participant complained of stinging on application of malathion, and the product was washed off early			

Malathion or permethrin versus mechanical eradication:

We found one RCT comparing "bug busting" (wet combing with conditioner) versus a single application of pediculicide (malathion 0.5% aqueous applied for 8 hours or overnight or permethrin 1% creme rinse applied for 10 minutes; see further information on studies below). [13]

Eradication rate

Malathion or permethrin compared with mechanical removal ("bug busting") Malathion or permethrin may be less effective at eradicating lice in a population with a high prevalence of insecticide resistance (very low-quality evidence).

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Eradication rate					
[13] RCT	133 children and adolescents aged 2 to 15 years	**Proportion of lice-free people, 5 days for the pediculicide group and 15 days for the "bug-busting" group** 9/70 (13%) with pediculicide 32/62 (52%) with "bug busting" Single application of pediculicide used; for full details, see further information on studies	Significance not reported		

Adverse effects

No data from the following reference on this outcome. [13]

Malathion versus dimeticone:

We found no systematic review but found one RCT comparing malathion versus dimeticone. [14] The RCT compared two applications of malathion 0.5% aqueous (applied for 8 hours or overnight) 7 days apart versus two applications of dimeticone 4% lotion (applied for 8 hours or overnight) 7 days apart.

Eradication rate

Compared with dimeticone Malathion seems to be less effective at reducing the proportion of people lice free after the second treatment or with no re-infestation after cure at 14 days (moderate-quality evidence).

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Eradication rates					
[14] RCT	73 children and adults	**Proportion of lice-free people after the second treatment, or no re-infestation after cure , 14 days** 10/30 (33%) with malathion 30/43 (70%) with dimeticone	ARR –36% 95% CI –60% to –13% P <0.01	○○○	dimeticone

Adverse effects

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Adverse effects					
[14] RCT	73 children and adults	**Adverse effects** with malathion with dimeticone The RCT reported no adverse effects associated with dimeticone 2/30 (7%) people reported itching or irritation of the neck or scalp during treatment with malathion			

Malathion versus pyrethrum or lindane:

We found no systematic review or RCTs.

Malathion versus herbal treatments:

We found no systematic review or RCTs.

Malathion versus trimethoprim–sulfamethoxazole (TMP-SMX, co-trimoxazole):

We found no systematic review or RCTs.

Malathion versus isopropyl myristate:
We found no systematic review or RCTs.

Malathion versus benzyl alcohol:
We found no systematic review or RCTs.

Malathion versus spinosad:
We found no systematic review or RCTs.

Malathion lotion versus oral ivermectin:
See option on ivermectin, p 29 .

Further information on studies

[9] The RCT comparing malathion versus phenothrin found that some children who were not lice free on day 1 were louse free by day 7 in both groups, suggesting that some parental intervention had influenced the results. The RCT also concluded that about 60% of treatments may have been affected by pyrethroid insecticide resistance. In vitro testing confirmed some lice as being tolerant of phenothrin.

[10] The stinging reported in one person using malathion was likely to be as a result of the vehicle used (alcohol with terpenoid).

[12] The RCT comparing "bug busting" versus malathion was designed to be a pragmatic RCT with results applicable to normal practice.

[13] The other RCT comparing "bug busting" versus malathion or permethrin used a single application of each product, which is not current best practice (see Clinical guide); in addition, the insecticide-treated group was only followed for 5 days, which is inadequate to confirm efficacy, as the eggs take 7 days to hatch. In the pediculicide group, 30 people (43%) received malathion and 40 people (57%) received permethrin. Most people in the pediculicide group who did not have successful eradication were found to have pyrethroid-resistant lice.

[8] The placebo-controlled RCT comparing malathion lotion versus the lotion vehicle used an alcohol-based lotion with added terpenoids likely to exert a therapeutic effect. The stinging reported for one person using malathion was attributed to irritation of existing pyoderma of the scalp by alcohol. Several other people (number not specified) also had pyoderma on the scalp. The reported outcomes in the study are for the per-protocol group. It did not do an intention-to-treat analysis. This study made the final assessment after 7 days only.

[11] The study was conducted in an isolated community of mainly migrant farm workers who had been exposed to agricultural pesticides. Re-treatment rates after 7 days, due to finding live lice, "ranged from 28% to 40%" for the malathion gel groups (actual rate for each group not identified), 32% for malathion lotion, and 70% for permethrin.

Comment:

Studies *in vitro* suggest that other components of the products (e.g., terpenoids and solvents) may be similarly effective pediculicides as the insecticide itself. [15] This is supported by the relatively high level of cure achieved using the formulation vehicle in some placebo-controlled trials. Resistance to one or more insecticides is now common. [16] [17] [18]

Clinical guide:
Current best practice is to treat with two applications of insecticide lotion 7 days apart to ensure treatment of louse nymphs emerging from eggs that were not killed by the first treatment. Most investigators agree that a final examination after 14 days is necessary to determine cure.

OPTION PERMETHRIN

- For GRADE evaluation of interventions for Head lice, see table, p 39 .
- Permethrin may be more effective at eradicating lice than placebo or lindane.
- Eradication may be increased by adding trimethoprim–sulfamethoxazole (TMP-SMX, co-trimoxazole).
- We found no clinically important results from RCTs about the effects of permethrin compared with phenothrin, pyrethrum, dimeticone, or herbal treatments.

Benefits and harms

Permethrin versus lindane:

We found one systematic review (search date 1995, 7 RCTs, 1808 people). [19]

Eradication rate

Compared with lindane Permethrin is more effective at increasing eradication rates (moderate-quality evidence).

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Eradication rate					
[19] Systematic review	802 people 2 RCTs in this analysis	**Eradication rates , 14 days** with permethrin (1% creme rinse) with lindane (1% shampoo) Absolute results not reported	OR for not clearing head lice 15.2 95% CI 8.0 to 28.8	●●●	permethrin

Adverse effects

No data from the following reference on this outcome. [19]

Permethrin versus placebo:

We found no systematic review but found one RCT. [20] The RCT (63 children and adults) compared permethrin 1% creme rinse (applied for 10 minutes) versus commercial creme rinse with 20% isopropanol (placebo). A non-randomised control group treated with lindane 1% shampoo was also included in the trial, which we have not reported further.

Eradication rate

Compared with placebo Permethrin seems to be more effective at eradicating head lice at 7 and 14 days (moderate-quality evidence).

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Eradication rate					
[20] RCT	63 children and adults with head lice	**Population louse free , 7 days** 29/29 (100%) with permethrin (1% creme rinse) 3/34 (9%) with placebo (commercial creme rinse and alcohol)	P <0.001	○○○	permethrin
[20] RCT	63 children and adults with head lice	**Proportion louse-free , 14 days** 28/29 (97%) with permethrin (1% creme rinse) 2/34 (6%) with placebo (commercial creme rinse plus alcohol)	P <0.001	○○○	permethrin

Permethrin versus phenothrin or pyrethrum:
We found no systematic review or RCTs comparing permethrin with these insecticides.

Permethrin versus malathion:
See option on malathion, p 3 .

Permethrin or malathion versus mechanical removal of lice:
See option on malathion, p 3 .

Permethrin versus herbal treatments:
See option on herbal treatments, p 17 .

Permethrin versus trimethoprim–sulfamethoxazole (TMP-SMX, co-trimoxazole):
See option on oral TMP-SMX, p 12 .

Permethrin versus dimeticone:
See option on dimeticone, p 14 .

Permethrin versus isopropyl myristate:
See option on isopropyl myristate, p 27 .

Permethrin versus ivermectin:
We found no systematic review or RCTs.

Permethrin versus benzyl alcohol:
We found no systematic review or RCTs.

Permethrin versus spinosad:
See option on spinosad, p 34 .

Combing plus insecticide versus insecticide alone:
See option on mechanical removal of lice or viable eggs by combing, p 22 .

Further information on studies

Comment: See comment on malathion, p 3 .

OPTION ORAL TRIMETHOPRIM–SULFAMETHOXAZOLE (TMP-SMX, CO-TRIMOXAZOLE)

- For GRADE evaluation of interventions for Head lice, see table, p 39 .
- Head lice eradication may be increased by adding oral trimethoprim–sulfamethoxazole (TMP-SMX, co-trimoxazole) to topical permethrin, although this also increased adverse effects.
- TMP-SMX is associated with intense pruritus after 3 to 4 days, and with potentially rare but serious adverse effects, including Stevens–Johnson syndrome, erythema multiforme, and blood disorders.
- We found no clinically important results from RCTs about the effects of TMP-SMX compared with placebo, malathion, phenothrin, pyrethrum, lindane, mechanical removal of lice, dimeticone, or herbal treatments.

Benefits and harms

Trimethoprim–sulfamethoxazole (TMP-SMX, co-trimoxazole; oral) versus permethrin:

We found one RCT comparing three treatments: oral trimethoprim–sulfamethoxazole (TMP-SMX, co-trimoxazole) alone (10 mg/kg/day over 10 days), permethrin 1% topical alone (1 application with a second 1 week later if required), and permethrin 1% topical plus oral TMP-SMX. [21]

Eradication rate

Compared with permethrin Trimethoprim–sulfamethoxazole (TMP-SMX, co-trimoxazole) may be as effective as permethrin when used as monotherapy to eradicate head lice (very low-quality evidence).

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Eradication rate					
[21] RCT **3-armed trial**	115 children aged 2 to 13 years The third arm evaluated permethrin 1% topical plus oral trimethoprim–sulfamethoxazole (TMP-SMX, co-trimoxazole)	**Proportion of people with absence of adult lice, nymphal stages, or eggs , 4 weeks** 28/36 (78%) with TMP-SMX alone 28/39 (72%) with permethrin alone	P = 0.74	⟷	Not significant

Trimethoprim–sulfamethoxazole (TMP-SMX, co-trimoxazole; oral) plus permethrin versus permethrin alone:

We found one RCT comparing three treatments: oral trimethoprim–sulfamethoxazole (TMP-SMX; co-trimoxazole) alone (10 mg/kg/day over 10 days), permethrin 1% topical alone (1 application with a second 1 week later if required), and permethrin 1% topical plus oral TMP-SMX. [21]

Eradication rate

Trimethoprim–sulfamethoxazole (TMP-SMX, co-trimoxazole) plus permethrin compared with permethrin alone
Combined treatment with TMP-SMX plus permethrin may be more effective at increasing eradication (very low-quality evidence).

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Eradication rate					
[21] RCT **3-armed trial**	115 children aged 2 to 13 years The third arm evaluated oral trimethoprim–sulfamethoxazole (TMP-SMX, co-trimoxazole) alone	**Proportion of people with absence of adult lice, nymphal stages, or eggs , 4 weeks** 37/40 (93%) with TMP-SMX plus permethrin 28/39 (72%) with permethrin alone	P = 0.03	○○○	TMP-SMX plus permethrin

Adverse effects

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Adverse effects					
[21] RCT **3-armed trial**	115 children aged 2 to 13 years	**Adverse effects** with TMP-SMX alone with permethrin alone with TMP-SMX plus permethrin Adverse effects with TMP-SMX included intense pruritus, nausea/vomiting, minor rash, or a combination 3 children reported scalp irritation with permethrin For full details see further information on studies, below			

Further information on studies

[21] The RCT (115 children) found that 5 children taking TMP-SMX reported nausea/vomiting, minor rash, or both, and that three children reported scalp irritation with permethrin. It found that 9/36 (25%) children developed intense pruritus after 3 to 4 days with TMP-SMX alone, but the pruritus disappeared after 1 to 3 hours and treatment was continued. Three children were withdrawn because of rash caused by TMP-SMX. Rare but serious potential adverse effects of TMP-SMX include Stevens–Johnson syndrome, erythema multiforme, and blood disorders. The RCT found no cases of these severe adverse effects with TMP-SMX.

Comment: **Clinical guide:**
Given the potential harms arising from the use of TMP-SMX, the relatively high incidence of other adverse effects, and the marginal benefit compared with conventional treatment, it is unlikely that TMP-SMX would present as a treatment of choice for head lice infestation. This might primarily be viewed as a therapeutic curiosity, especially as alternative treatment not involving potentially toxic agents (e.g., with materials like dimeticone) is likely to become standard practice in the next few years.

OPTION COMBINATIONS OF INSECTICIDES

- For GRADE evaluation of interventions for Head lice, see table, p 39 .
- We don't know whether combinations of insecticides are beneficial compared with single agents or other treatments.

- We found no RCTs comparing combinations of insecticides versus single agents, trimethoprim–sulfamethoxazole (TMP-SMX, co-trimoxazole), or mechanical removal of lice.

Benefits and harms

Combinations of insecticides versus placebo:

We found no systematic review or RCTs.

Combinations of insecticides versus herbal treatment:

See option on herbal treatments, p 17 .

Combinations of insecticides versus single agents:

We found no systematic review or RCTs comparing combinations of insecticides with single non-herbal agents.

Combinations of insecticides versus trimethoprim–sulfamethoxazole (TMP-SMX, co-trimoxazole):

We found no systematic review or RCTs.

Further information on studies

Comment: None.

OPTION DIMETICONE

- For GRADE evaluation of interventions for Head lice, see table, p 39 .
- Dimeticone may be more effective at eradicating lice compared with malathion.
- Dimeticone may be more effective at eradicating lice compared with permethrin.
- Dimeticone and phenothrin have produced similar results, but this may be because of varying insecticide resistance and the formulation of phenothrin used.
- We found no clinically important results from RCTs about the effects of dimeticone compared with placebo, herbal and essential oils, lindane, mechanical removal, pyrethrum, oral trimethoprim–sulfamethoxazole (TMP-SMX, co-trimoxazole), isopropyl myristate, ivermectin, benzyl alcohol, or spinosad.

Benefits and harms

Dimeticone versus phenothrin:

We found one RCT comparing phenothrin 0.5% aqueous liquid versus dimeticone 4% in a volatile silicone vehicle (both groups used 2 applications 7 days apart). [22]

Eradication rate

Compared with phenothrin Dimeticone 4% lotion and phenothrin 0.5% liquid seem equally effective at eradicating lice (moderate-quality evidence).

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Eradication rate					
[22] RCT	214 young people and 39 adults	**Proportion of lice-free people after the second treatment, or no re-infestation after cure** 89/127 (70%) with dimeticone 94/125 (75%) with phenothrin	ARR –5% 95% CI –16% to +6%	⟷	Not significant

Adverse effects

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Irritant scalp reactions					
[22] RCT	214 young people and 39 adults	**Irritant scalp reactions** 3/127 (2%) with dimeticone 11/125 (9%) with phenothrin	ARR 6% 95% CI 1% to 12%	○○○	dimeticone

Dimeticone versus permethrin:

We found one RCT comparing dimeticone 92% lotion versus permethrin 1% aqueous lotion (both groups used 2 applications 7 days apart). [23]

Eradication rate

Compared with permethrin Dimeticone lotion may be more effective than aqueous permethrin lotion at increasing head lice eradication rates at 9 days (by which time 2 applications of each drug had been given) but not at 7 days (low-quality evidence).

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Eradication rate					
[23] RCT	145 children aged 5 to 15 years with head lice	**Proportion louse-free , 7 days (before second treatment)** 47/73 (64%) with dimeticone 43/72 (60%) with permethrin	RR 1.22 95% CI 0.59 to 2.52 P = 0.5 See further information on studies	⟷	Not significant
[23] RCT	145 children aged 5 to 15 years with head lice	**Proportion louse-free , 9 days** 70/72 (97%) with dimeticone 48/71 (67%) with permethrin	RR 1.44 95% CI 1.22 to 1.70 P <0.0001 See further information on studies	●○○	dimeticone

Adverse effects

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Adverse effects					
[23] RCT	145 children aged 5 to 15 years with head lice	**Ocular irritation due to product running into eyes** 2 people with dimeticone	Significance not reported		

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
		0 people with permethrin			

Dimeticone versus herbal products:
We found no systematic review or RCTs.

Dimeticone versus placebo:
We found no systematic review or RCTs.

Dimeticone versus malathion:
See option on malathion, p 3 .

Dimeticone versus herbal and essential oils:
We found no systematic review or RCTs.

Dimeticone versus mechanical removal of lice:
We found no systematic review or RCTs.

Dimeticone versus pyrethrum:
We found no systematic review or RCTs.

Dimeticone versus trimethoprim–sulfamethoxazole (TMP-SMX, co-trimoxazole):
We found no systematic review or RCTs.

Dimeticone versus isopropyl myristate:
We found no systematic review or RCTs.

Dimeticone versus ivermectin:
We found no systematic review or RCTs.

Dimeticone versus benzyl alcohol:
We found no systematic review or RCTs.

Dimeticone versus spinosad:

We found no systematic review or RCTs.

Further information on studies

[23] This study was terminated for logistical reasons following the assessment on day 9, which is 5 days fewer than the normal primary endpoint assessment day. This study used "wet combing with conditioner", which can be used as a treatment intervention, to evaluate efficacy between applications of treatments (see comment for combing versus phenothrin, p 22).

Comment:

Clinical guide:

Dimeticone does not act on the insect nervous system and is unlikely to be affected by resistance to other insecticides. Some RCTs were conducted in an area where resistance to insecticides is widespread, [14] [22] whereas others were conducted in countries or communities where access to pediculicides may be limited and lice may not be resistant to insecticides. The greater diversity of product specifications and study sites suggest that the results may be more generalisable than previously considered. See comment on phenothrin, p 24 .

OPTION HERBAL AND ESSENTIAL OILS

- For GRADE evaluation of interventions for Head lice, see table, p 39 .
- Herbal and essential oil treatment may be more effective at eradicating lice compared with permethrin.
- We don't know whether herbal and essential oils eradicate lice compared with other treatments.
- We found no clinically important results from RCTs about the effects of herbal products compared with placebo, malathion, permethrin, phenothrin, pyrethrum, lindane, dimeticone, or trimethoprim–sulfamethoxazole (TMP-SMX, co-trimoxazole).

Benefits and harms

Herbal and essential oils versus combined insecticides:

We found one RCT (143 children) comparing a spray based on herbal oils (coconut, anise, and ylang ylang; concentrations unspecified) versus an insecticide spray (permethrin 0.5% plus malathion 0.25%, synergised with piperonyl butoxide 2%). [24] The herbal spray was used three times at 5-day intervals and the insecticide twice with 10 days between applications.

Eradication rate

Compared with combined insecticide A herbal product (coconut, anise, and ylang ylang) may be as effective as a combination of insecticides (permethrin plus malathion, synergised with piperonyl butoxide) at eradicating head lice (very low-quality evidence).

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Eradication rate					
[24] RCT	143 children	**Eradication rate** 60/70 (86%) with herbal product 59/73 (81%) with insecticide	Reported as not significant P value not reported	⟷	Not significant

Adverse effects

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Adverse effects					
[24] RCT	143 children	**Adverse effects** with herbal product with insecticide The RCT found no clinically detectable adverse effects with either herbal oils or insecticide spray			

Herbal and essential oils versus permethrin:

We found no systematic review. We found one RCT comparing a spray based on herbal oils (coconut, anise, and ylang ylang; concentrations unspecified) versus permethrin 0.5% alcoholic lotion. [25] Both products were applied twice with 9 days between treatments.

Eradication rate

Compared with permethrin A specific herbal product (coconut, anise, and ylang ylang; concentrations unspecified) may be more effective at eradicating head lice at 14 days. We found no evidence on other herbal products versus permethrin (low-quality evidence).

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Eradication rate					
[25] RCT	100 children and adults with head lice	**Eradication rate , 7 days** 27/50 (54%) with herbal product 19/50 (38%) with permethrin	P <0.05	○○○	herbal product
[25] RCT	100 children and adults with head lice	**Eradication rate , 14 days** 41/50 (82%) with herbal product 21/50 (42%) with permethrin	ARR 40.0% 95% CI 22.5% to 57.5% P <0.0001	○○○	herbal product

Adverse effects

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Adverse effects					
[25] RCT	100 children and adults with head lice	**Adverse effects related to study treatment** with herbal product with permethrin 20 participants reported 31 adverse events with permethrin 17 participants reported 24 adverse effects with herbal oils These were mostly stinging or burning sensations	Statistical analysis between groups was not performed		

Herbal and essential oils versus malathion:

We found no systematic review or RCTs.

Herbal and essential oils versus placebo:
We found no systematic review or RCTs.

Herbal and essential oils versus phenothrin:
We found no systematic review or RCTs.

Herbal and essential oils versus pyrethrum:
We found no systematic review or RCTs.

Herbal and essential oils versus lindane:
We found no systematic review or RCTs.

Herbal and essential oils versus dimeticone:
We found no systematic review or RCTs.

Herbal and essential oils versus trimethoprim–sulfamethoxazole (TMP-SMX, co-trimoxazole):
We found no systematic review or RCTs.

Herbal and essential oils versus mechanical removal of lice:
We found no systematic review or RCTs.

Herbal or essential oils versus isopropyl myristate:
We found no systematic review or RCTs.

Herbal and essential oils versus ivermectin:
We found no systematic review or RCTs.

Herbal and essential oils versus benzyl alcohol:
We found no systematic review or RCTs.

Herbal and essential oils versus spinosad:
We found no systematic review or RCTs.

Further information on studies

[24] Results are not generalisable to different concentrations of these herbal ingredients or to other herbal or essential oil products. The study may not be generalisable as the herbal treatment regimen was non-standard and the withdrawal rate was high.

[25] Results are not generalisable to different concentrations of these herbal ingredients or to other herbal or essential oil based products.

Comment:

Clinical guide:
Sprays are not a good vehicle for delivery of pediculicides owing to the risks of inhalation and of spraying into the eyes.

Alcohol and other essential oil based preparations have the potential to cause irritation of excoriated skin. Several essential oil components are considered to be sensitising agents. [26]

A potential for toxic effects has been recognised for several essential oils. [27]

OPTION LINDANE

- For GRADE evaluation of interventions for Head lice, see table, p 39 .
- The possibility of central nervous system toxicity from lindane has led to its withdrawal in some countries.
- We found no clinically important results from RCTs about the effects of lindane compared with placebo, other insecticides, mechanical removal of lice, dimeticone, herbal treatments, trimethoprim–sulfamethoxazole (TMP-SMX, co-trimoxazole), isopropyl myristrate, ivermectin, benzyl alcohol, or spinosad.

Benefits and harms

Lindane versus permethrin:

See option on permethrin, p 10 .

Lindane versus placebo:

We found no systematic review or RCTs.

Lindane versus malathion:

We found no systematic review or RCTs.

Lindane versus phenothrin:

We found no systematic review or RCTs.

Lindane versus phenothrin:

We found no systematic review or RCTs.

Lindane versus pyrethrum:
We found no systematic review or RCTs.

Lindane versus mechanical removal of lice:
We found no systematic review or RCTs.

Lindane versus herbal treatments:
We found no systematic review or RCTs.

Lindane versus dimeticone:
We found no systematic review or RCTs.

Lindane versus trimethoprim–sulfamethoxazole (TMP-SMX, co-trimoxazole):
We found no systematic review or RCTs.

Lindane versus isopropyl myristate:
We found no systematic review or RCTs.

Lindane versus ivermectin:
We found no systematic review or RCTs.

Lindane versus benzyl alcohol:
We found no systematic review or RCTs.

Lindane versus spinosad:
We found no systematic review or RCTs.

Further information on studies

Comment: **Clinical guide:**
There are extensive reports of central nervous system effects related to overdosing (treatment of scabies) and absorption (treatment of head lice) with lindane. Transdermal passage of lindane occurs during treatment of head lice, [28] but we found no reports of adverse effects in this setting.

OPTION MECHANICAL REMOVAL OF LICE OR VIABLE EGGS BY COMBING

- For GRADE evaluation of interventions for Head lice, see table, p 39 .
- Trials comparing placebo, malathion, or permethrin with wet combing have given conflicting results, possibly because of varying insecticide resistance.
- We found no clinically important results from RCTs about the effects of mechanical removal compared with pyrethrum, dimeticone, or lindane.

Benefits and harms

Combing plus insecticide versus insecticide alone:

We found one RCT (95 adults and children) comparing combing with a metal louse/nit comb plus permethrin 1% creme rinse versus permethrin creme rinse alone. [29] In both groups, permethrin was applied by a community practitioner, and if lice were found after 7 days there was a further application of permethrin, or permethrin plus combing.

Eradication rate

Permethrin plus adjuvant combing compared with permethrin alone Permethrin plus adjuvant combing (using a metal comb) may be no more effective at eradicating lice (low-quality evidence).

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Eradication rate					
[29] RCT	95 adults and children	**Proportion of lice-free people, 2 days** 24/33 (73%) with combing 49/59 (83%) with no combing	RR 1.14 95% CI 0.90 to 1.50	⟷	Not significant
[29] RCT	95 adults and children	**Proportion of lice-free people, 8 days (before repeat treatment)** 11/33 (33%) with combing 27/59 (46%) with no combing	RR 0.92 95% CI 0.60 to 1.40	⟷	Not significant
[29] RCT	95 adults and children	**Proportion of lice-free people, 15 days** 24/33 (73%) with combing 47/60 (78%) with no combing	RR 1.08 95% CI 0.80 to 1.40	⟷	Not significant

Adverse effects

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Adverse effects					
[29] RCT	95 adults and children	**Adverse effects** with combing with no combing Apart from discomfort, no adverse effects from combing were reported			

Combing versus malathion:

See option on malathion, p 3 .

Combing versus placebo:
We found no systematic review or RCTs.

Combing versus malathion or permethrin:
See option on malathion, p 3 .

Combing versus permethrin:
We found no systematic review or RCTs comparing combing alone versus permethrin.

Combing plus phenothrin versus mechanical removal of lice:
See option on phenothrin, p 24 .

Combing versus pyrethrum:
We found no systematic review or RCTs.

Combing versus lindane:
We found no systematic review or RCTs.

Combing versus dimeticone:
We found no systematic review or RCTs.

Combing plus combination insecticides:
We found two RCTs comparing different pediculicides in combination with nit combing, but neither included a non-combing or non-insecticide control group. [30] [31]

Combing versus isopropyl myristate:
We found no systematic review or RCTs.

Combing versus ivermectin:
We found no systematic review or RCTs.

Combing versus benzyl alcohol:
We found no systematic review or RCTs.

Combing versus spinosad:

We found no systematic review or RCTs.

Further information on studies

Comment:

Combing versus malathion:
The RCT comparing "bug busting" versus malathion was designed as a pragmatic RCT with results applicable to normal practice. [12]

Combing versus phenothrin: [32]
It is possible that some of the effect attributed to the combing element of "bug busting" may actually be caused by the activity of conditioners on head lice and their eggs. A non-RCT has indicated that a conditioner-like formulation was an effective pediculicide if allowed to dry on the hair. [33] A similar effect could occur if combing during "bug busting" takes long enough.

Wet combing with conditioner may cause adverse reactions, which have been observed during normal cosmetic use. [34] [35] [36] [37]

OPTION PHENOTHRIN

- For GRADE evaluation of interventions for Head lice, see table, p 39 .
- Phenothrin and dimeticone have produced similar results, but this may be because of varying insecticide resistance and the formulation of phenothrin used.
- We found no clinically important results from RCTs about the effects of phenothrin compared with permethrin, pyrethrum, or lindane.

Benefits and harms

Phenothrin versus mechanical removal of lice:

We found no systematic review but we found one RCT (30 people) comparing "bug busting" versus phenothrin alcoholic lotion (2 applications 7 days apart, concentration not reported) plus combing. [38]

Eradication rate

Phenothrin plus combing compared with mechanical removal ("bug busting") Phenothrin plus combing may be less effective at eradicating head lice (very low-quality evidence).

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Eradication rate					
[38] RCT	30 people	**Eradication rate , 14 days** 2/15 (13%) with phenothrin 8/15 (53%) with "bug busting" Results may have been confounded by other differences between treatment groups; for full details, see further information on studies	RR 0.25 95% CI 0.06 to 1.00	●○○	"bug busting"

Adverse effects

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Adverse effects					
[38] RCT	30 people	**Adverse effects** with phenothrin with "bug busting" The RCT reported no harms throughout the study period			

Phenothrin versus malathion:
See option on malathion, p 3 .

Phenothrin versus placebo:
We found no systematic review or RCTs.

Phenothrin versus permethrin:
We found no systematic review or RCTs.

Phenothrin versus pyrethrum:
We found no systematic review or RCTs.

Phenothrin versus lindane:
We found no systematic review or RCTs.

Phenothrin versus herbal treatments:
We found no systematic review or RCTs.

Phenothrin versus dimeticone:
See option on dimeticone, p 14 .

Phenothrin versus trimethoprim–sulfamethoxazole (TMP-SMX, co-trimoxazole):
We found no systematic review or RCTs.

Phenothrin versus isopropyl myristate:
We found no systematic review or RCTs.

Phenothrin versus ivermectin:
We found no systematic review or RCTs.

Phenothrin versus benzyl alcohol:
We found no systematic review or RCTs.

Phenothrin versus spinosad:
We found no systematic review or RCTs.

Further information on studies

[38] In the RCT comparing "bug busting" with phenothrin lotion, the interventions were applied by trained nurses. "Bug busting" involved the use of different graded combs and specific hair conditioner, whereas people in the phenothrin group used a single head-lice comb and unspecified hair conditioners. The follow-up strategy for the combing group differed from that offered to the lotion group. This difference may introduce bias and confounding. The RCT was conducted in an area where resistance to pyrethroid insecticides was widespread. The results of this RCT may not be generalisable to other product formulations and application times.

Comment: See comment on malathion, p 3 .

Clinical guide:
Phenothrin has now been withdrawn from the UK but is still used in some other European countries.

OPTION PYRETHRUM

- For GRADE evaluation of interventions for Head lice, see table, p 39 .
- We don't know whether pyrethrum is beneficial compared with placebo, other insecticides, mechanical removal of lice, herbal treatments, trimethoprim–sulfamethoxazole (TMP-SMX, co-trimoxazole), ivermectin, or spinosad, as no RCTs have been found.

Benefits and harms

Pyrethrum versus other insecticides:
We found no systematic review or RCTs.

Pyrethrum versus mechanical removal of lice:
We found no systematic review or RCTs.

Pyrethrum versus herbal treatments:
We found no systematic review or RCTs.

Pyrethrum versus dimeticone:
We found no systematic review or RCTs.

Pyrethrum versus trimethoprim–sulfamethoxazole (TMP-SMX, co-trimoxazole):
We found no systematic review or RCTs.

Pyrethrum versus isopropyl myristate:
See benefits and harms of isopropyl myristate.

Pyrethrum versus ivermectin:
We found no systematic review or RCTs.

Pyrethrum versus benzyl alcohol:
See option on benzyl alcohol, p 32 .

Pyrethrum versus spinosad:
We found no systematic review or RCTs.

Pyrethrum versus placebo:
We found no systematic review or RCTs.

Further information on studies

Comment: See comment on malathion, p 3 .

OPTION **ISOPROPYL MYRISTATE** New

- For GRADE evaluation of interventions for Head lice, see table, p 39 .
- Isopropyl myristate may be more effective at eradicating lice compared with permethrin.
- There is some evidence that isopropyl myristate may be more effective at eradicating lice compared with pyrethrum.
- We don't know whether isopropyl myristate is beneficial compared with placebo, malathion, lindane, phenothrin, combinations of insecticides, dimeticone, mechanical removal of lice, herbal treatments, trimethoprim–sulfamethoxazole (TMP-SMX, co-trimoxazole), ivermectin, benzyl alcohol, or spinosad, as no RCTs have been found.

Benefits and harms

Isopropyl myristate versus permethrin:

We found no systematic review but found one RCT. [39] This RCT (168 people) compared IPM 50% (isopropyl myristate/cyclomethicone) versus permethrin 1% creme rinse, both applied for 10 minutes on two occasions 7 days apart. See further information on studies.

Eradication rate

Compared with permethrin Isopropyl myristate lotion may be more effective at increasing lice eradication rates at 14 days (low-quality evidence).

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Eradication rate					
[39] RCT	168 people (141 children, 27 adults)	**Eradication rate , 14 days** 91/111 (82%) with isopropyl myristate (IPM) 11/57 (19%) with permethrin	Difference 63% 95% CI 50% to 75% P <0.001	○○○	IPM

Adverse effects

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Adverse effects					
[39] RCT	168 people (141 children, 27 adults)	**Adverse effects** with IPM with permethrin	Reported as no significant difference between groups in frequency, duration, or severity of adverse effects	⟷	Not significant

Isopropyl myristate versus pyrethrum:

We found no systematic review but found one RCT. [40] This RCT (60 people) compared isopropyl myristate (IPM) 50% with pyrethrum 0.33% synergised with piperonyl butoxide 4% shampoo, both applied for 10 minutes. IPM was applied on up to three occasions 1 week apart, depending on whether lice were present at an assessment. Pyrethrum shampoo was applied on two occasions with 1 week between applications.

Eradication rate

Compared with pyrethrum Isopropyl myristate may be more effective at increasing lice eradication rates compared with pyrethrum shampoo at 14 to 21 days (low-quality evidence).

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Eradication rate					
[40] RCT	60 children and adults with head lice	**Eradication rate , 7 days** with isopropyl myristate (IPM) with RID control (pyrethrin 0.33% and piperonyl butoxide 4%) Absolute results reported graphically	P = 0.5 See further information on studies	⟷	Not significant
[40] RCT	60 children and adults with head lice	**Eradication rate , 14 days** with IPM with pyrethrum	P = 0.0236 See further information on studies	○○○	IPM

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
		Absolute results reported graphically			
[40] RCT	60 children and adults with head lice	**Eradication rate , 21 days** with IPM with pyrethrum Absolute results reported graphically	P = 0.0021 See further information on studies	○○○	IPM

Adverse effects

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Adverse effects					
[40] RCT	60 children and adults with head lice	**Adverse effects** with IPM with pyrethrum	22 events reported, both treatments "showed similar profiles consistent with those observed for other pediculicides" Significance and P value not reported		

Further information on studies

[40] In the RCT all participants were treated on day 0, but were re-treated on either day 7 or day 14, or both, only if lice were found. Six of 60 (10%) people left the study before the endpoints. This study also reported results of a non-RCT proof of concept trial using IPM plus combing.

[39] This study reported two smaller RCTs with similar methods analysed as one. The randomisation of the first trial (74 participants) was 1:1 (IPM:permethrin) and that of the second (94 participants) was 4:1 (IPM:permethrin). However, the second RCT was terminated prematurely for commercial reasons.

Comment: The RCT comparing isopropyl myristate versus pyrethrum [40] mainly reported outcomes as reductions in louse numbers per assessment rather than elimination of infestation. We have only reported people who were free of adult and nymphal lice.

OPTION IVERMECTIN (ORAL) New

- For GRADE evaluation of interventions for Head lice, see table, p 39 .
- Oral ivermectin is likely to be beneficial in eradicating lice compared with malathion in people with failed topical insecticide treatment.
- Ivermectin may be associated with adverse effects.
- However, although tested in a clinical trial, oral ivermectin is not currently licensed for treating head lice, and generally its likely usefulness has been superseded by the introduction of physically acting chemicals that are not affected by resistance and are generally considered safer.
- We don't know whether ivermectin is beneficial compared with placebo, permethrin, lindane, phenothrin, combinations of insecticides, dimeticone, mechanical removal of lice, herbal treatments, trimethoprim–sulfamethoxazole (TMP-SMX, co-trimoxazole), isopropyl myristate, benzyl alcohol, or spinosad, as no RCTs have been found.

Benefits and harms

Oral ivermectin versus placebo:

We found no systematic review or RCTs.

Oral ivermectin versus malathion lotion:

We found no systematic review, but found one cluster-randomised, double-blind, double-dummy RCT. [41] The RCT compared malathion 0.5% alcoholic lotion (applied for 10–12 hours plus placebo tablets) versus oral dosing with 400 micrograms/kilogram ivermectin tablets (plus placebo lotion). Both products were applied once, with a second application after 7 days. The unit of randomisation was households. It included people with live lice not eradicated by topical insecticide used 2 to 6 weeks before enrolment ("previously failed treatment in either the index case or a household member defined as persistence of head lice infestation despite topical application of a pyrethoid-based or malathion insecticide 2–6 weeks before day 1 visit as reported by the patient or guardian"). Ivermectin is prescription only and is not currently licensed for this use in any country (see comments below).

Eradication rate

Compared with malathion Oral ivermectin seems to be more effective at increasing eradication of head lice at 7 and 14 days in people with previous failed treatment with insecticides (moderate-quality evidence).

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Eradication rate					
[41] RCT	812 children and adults with head lice in 376 households	**Proportion of people head-lice free , 7 days** 223/414 (54%) with malathion 332/397 (84%) with ivermectin	ARR –30% 95% CI –37% to –22% P <0.001	○○○	ivermectin
[41] RCT	812 children and adults with head lice in 376 households	**Proportion of people head-lice free , 14 days** 352/414 (85%) with malathion 378/397 (95%) with ivermectin	ARR –10% 95% CI –16% to –5% P <0.001	○○○	ivermectin

Adverse effects

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Adverse effects					
[41] RCT	812 children and adults with head lice in 376 households	**Treatment-related adverse effects** 45/414 (11%) with malathion 30/398 (8%) with ivermectin Treatment-related adverse effects were those classified as possibly, probably, or definitely related to the study drug by the investigator. See further information on studies	P = 0.12 See further information about studies.	⟷	Not significant

Oral ivermectin versus malathion:

We found no systematic review or RCTs.

Oral ivermectin versus other insecticides:
We found no systematic review or RCTs.

Oral ivermectin versus mechanical removal of lice:
We found no systematic review or RCTs.

Oral ivermectin versus combinations of insecticides:
We found no systematic review or RCTs.

Oral ivermectin versus dimeticone:
We found no systematic review or RCTs.

Oral ivermectin versus trimethoprim–sulfamethoxazole (TMP-SMX, co-trimoxazole):
We found no systematic review or RCTs.

Oral ivermectin versus isopropyl myristate:
We found no systematic review or RCTs.

Oral ivermectin versus benzyl alcohol:
We found no systematic review or RCTs.

Oral ivermectin versus spinosad:
We found no systematic review or RCTs.

Further information on studies

[41] The overall withdrawal rate in this study was 99/812 (12%). The RCT comparing ivermectin versus malathion reported two serious adverse events not considered related to treatment: a seizure in the ivermectin group followed by withdrawal and a headache requiring hospital observation in the malathion group. Overall there were 12 withdrawals because of adverse events (7 ivermectin group, 5 malathion group). Reported adverse events included gastrointestinal disturbances, including nausea and vomiting, application-site pain, rash and erythema, and headaches as principal events in both treatment groups. The malathion lotion used in this study contained terpenoids in addition to malathion and alcohol.

[41] **Adverse effects:** Ivermectin has been associated with reports of rare severe adverse effects (see scabies review). Ivermectin may also be associated with fever, gastrointestinal symptoms, skin rashes and pruritus, among other adverse effects.

Comment: Oral ivermectin is currently not licensed for this application in any country. It is only ever likely to be considered a second- or third-line treatment as currently it is only available on a named patient basis and generally its likely usefulness has been superseded by the introduction of physically acting chemicals that will not be affected by resistance and are generally considered safer.

OPTION BENZYL ALCOHOL New

- For GRADE evaluation of interventions for Head lice, see table, p 39 .
- There is evidence that benzyl alcohol may be more effective at eradicating lice compared with placebo.
- We don't know whether benzyl alcohol is beneficial compared with insecticides, combinations of insecticides, dimeticone, mechanical removal of lice, herbal treatments, trimethoprim–sulfamethoxazole (TMP-SMX, co-trimoxazole), isopropyl myristate, ivermectin, or spinosad, as no RCTs have been found.

Benefits and harms

Benzyl alcohol versus placebo:

We found no systematic review but found one report of two RCTs. [42] The paper reported two RCTs (both enrolling 125 children) that compared benzyl alcohol 5% lotion (applied for 10 minutes) versus the benzyl alcohol lotion vehicle (applied for 10 minutes) on two occasions 1 week apart.

Eradication rate

Compared with placebo Benzyl alcohol seems to be more effective at increasing lice eradication rates at 14 days (moderate-quality evidence).

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Eradication rate					
[42] RCT	125 children (RCT 1) Data from 1 RCT	**Proportion louse-free , 1 day after second treatment** 97.6% with benzyl alcohol 16.4% with placebo Absolute numbers not reported	P <0.001	○○○	benzyl alcohol
[42] RCT	125 children (RCT 1) Data from 1 RCT	**Proportion louse-free , 2 weeks after treatment** 76.2% with benzyl alcohol 4.8% with placebo Absolute numbers not reported	P <0.001 ARR 71.4% 95% CI 61.8% to 85.7%	○○○	benzyl alcohol
[42] RCT	125 children (RCT 2) Data from 1 RCT	**Proportion louse-free , 1 day after second treatment** 85.7% with benzyl alcohol 39.3% with placebo Absolute numbers not reported	P <0.001	○○○	benzyl alcohol
[42] RCT	125 children (RCT 2) Data from 1 RCT	**Proportion louse-free , 2 weeks after treatment** 75.0% with benzyl alcohol 26.2% with placebo Absolute numbers not reported	P <0.001 ARR 48.8% 95% CI 31.1% to 62.0%	○○○	benzyl alcohol

Adverse effects

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Adverse effects					
[42] Non-systematic review	852 children and adults 5 RCTs in this analysis Five phase 2 and 3 trials in this analysis	**Adverse effects** 33/485 (7%) with benzyl alcohol 15/340 (4%) with placebo Most adverse effects were application-site disorders including irritation, anaesthesia, hypoaesthesia and pain at the application site See further information on studies			

Benzyl alcohol versus insecticides:
We found no systematic review or RCTs.

Benzyl alcohol versus mechanical removal of lice:
We found no systematic review or RCTs.

Benzyl alcohol versus combinations of insecticides:
We found no systematic review or RCTs.

Benzyl alcohol versus dimeticone:
We found no systematic review or RCTs.

Benzyl alcohol versus trimethoprim–sulfamethoxazole (TMP-SMX, co-trimoxazole):
We found no systematic review or RCTs.

Benzyl alcohol versus isopropyl myristate:
We found no systematic review or RCTs.

Benzyl alcohol versus ivermectin:
We found no systematic review or RCTs.

Benzyl alcohol versus spinosad:
We found no systematic review or RCTs.

Further information on studies

[42] This study report incorporated three phase 2 studies and two phase 3 studies. The first phase 2 study (40 people) compared two concentrations (5% and 10%) of benzyl alcohol with synergised pyrethrin shampoo, in which it was found that the dosing level for benzyl alcohol (up to 118 mL) was too low. The second phase 2 study (44 people) compared two application times (10 and 30 minutes) for benzyl alcohol lotion. The third phase 2 study (number of people not reported) determined the minimum effective dose for two 10-minute treatments using either benzyl alcohol 2.5% or 5% lotion. The phase 3 studies were both placebo-controlled rather than using a comparative pediculicide treatment. Both phase 3 studies were pragmatic with final assessment 21 days after the first treatment. The safety data reported were cumulative data from all 5 studies plus treated, non-randomised family members from the phase 3 studies.

Comment: The data from the report are difficult to interpret because in most cases actual numbers of participants in any outcome group are not given (only percentages). [42] It is debatable whether a placebo-controlled study should be classed as a phase 3 study because the outcome results obtained cannot be related to the outcome data generated from use of a recognised treatment product. We found RCT evidence that benzyl alcohol may be better than placebo. However, in clinical practice the choice is between different active agents. We found no evidence against other active agents, hence, we have categorised benzyl alcohol as Unknown effectiveness.

OPTION SPINOSAD New

- For GRADE evaluation of interventions for Head lice, see table, p 39 .
- There is evidence that spinosad may be more effective at eradicating lice compared with permethrin.
- We don't know whether spinosad is beneficial compared with placebo, other insecticides, combinations of insecticides, dimeticone, mechanical removal of lice, herbal treatments, trimethoprim–sulfamethoxazole (TMP-SMX, co-trimoxazole), isopropyl myristate, ivermectin, or benzyl alcohol, as no RCTs have been found.

Benefits and harms

Spinosad versus permethrin:

We found no systematic review but found one report, which included two RCTs. [43] The paper reported two RCTs comparing spinosad 0.9% creme rinse (applied for 10 minutes) without nit combing versus permethrin 1% creme rinse (applied for 10 minutes) plus nit combing. Both treatment regimens were given on up to two occasions 1 week apart. The RCT included a third arm of spinosad creme rinse plus combing and was randomised on a 4:4:1 basis (spinosad without combing; permethrin with combing; spinosad with combing). This third arm was not reported in the analysis of lice clearance at 14 days, but was included in the analysis of adverse effects. In the first RCT, households were randomised and all members of the household treated with spinosad without combing (91 households, 243 participants) or permethrin with combing (89 households, 256 participants). In the second RCT, households were treated with spinosad without combing (83 households, 203 people) or permethrin with combing (84 households, 214 people). The primary endpoint was the proportion of primary participants (defined as the youngest person in the household with 3 or more live lice present at day 0 [180 primary participants in the first RCT; 167 primary participants in the second RCT]) who were lice free at 14 days after the last treatment. People clear of lice at day 7 were assessed at day 14, while people not clear at day 7 received a further treatment and were assessed at day 21. We have reported this analysis below.

Eradication rate

Compared with permethrin Spinosad may be more effective at increasing lice eradication rates at 14 days after the last treatment (low-quality evidence).

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Eradication rate					
[43] RCT **3-armed trial**	180 primary participants from first RCT Data from 1 RCT	**No live lice present at 14 days after last treatment** 84.6% with spinosad without combing	P <0.01 See further information on studies	◌◌◌	spinosad

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
		44.9% with permethrin with combing Absolute results reported graphically			
[43] RCT **3-armed trial**	167 primary participants from the second RCT Data from 1 RCT	**No live lice present at 14 days after last treatment** 86.7% with spinosad without combing 42.9% with permethrin with combing Absolute results reported graphically	P <0.01 See further information on studies	○○○	spinosad

Adverse effects

Ref (type)	Population	Outcome, Interventions	Results and statistical analysis	Effect size	Favours
Adverse effects					
[43] RCT **3-armed trial**	1038 children and adults. See further information on studies 2 RCTs in this analysis	**Adverse effects** 34/552 (6%) with spinosad 53/457 (12%) with permethrin Adverse effects consisted of ocular hyperaemia and application-site disorders with both spinosad and permethrin			

Spinosad versus placebo:
We found no systematic review or RCTs.

Spinosad versus other insecticides:
We found no systematic review or RCTs.

Spinosad versus mechanical removal of lice:
We found no systematic review or RCTs.

Spinosad versus combinations of insecticides:
We found no systematic review or RCTs.

Spinosad versus dimeticone:
We found no systematic review or RCTs.

Spinosad versus trimethoprim–sulfamethoxazole (TMP-SMX, co-trimoxazole):
We found no systematic review or RCTs.

Spinosad versus isopropyl myristate:
We found no systematic review or RCTs.

Spinosad versus ivermectin:
We found no systematic review or RCTs.

Further information on studies

[43] This report consisted of two separate RCTs that had similar methods. There were 89 withdrawals (9%) for various reasons. All participants received one treatment. If lice were found on day 7, a second treatment was given. The RCT reported that the proportion of people who only required one treatment was higher in the spinosad without combing group than in the permethrin with combing group in both RCTs (results presented graphically). This was a pragmatic study with the final assessment 14 days after the last treatment.

Comment: We have reported the primary endpoint of the RCTs (primary participants louse free at 14 days after last treatment). [43] The report stated that that results were similar when data from all participants receiving one or two treatments were analysed (further details not reported). However, this is a difficult study to evaluate as actual numbers of participants given for outcomes at any particular stage do not relate to the whole study population; and for the final outcome only a percentage success rate is given.

GLOSSARY

High-quality evidence Further research is very unlikely to change our confidence in the estimate of effect.

Low-quality evidence Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.

Moderate-quality evidence Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate.

Pediculicide Any compound or material (possibly a pesticide) that kills lice. This term is used specifically in place of "insecticide" as not all pediculicides are recognised pesticides. A pediculicide is distinct from an "ovicide", which kills louse eggs, although one substance may fulfil both functions.

Pragmatic RCT An RCT designed to provide results that are directly applicable to normal practice (compared with explanatory trials that are intended to clarify efficacy under ideal conditions). Pragmatic RCTs recruit a population that is representative of those who are normally treated, allow normal compliance with instructions (by avoiding incentives and by using oral instructions with advice to follow manufacturers' instructions), and analyse results by "intention to treat" rather than by "on treatment" methods.

Scalp pyoderma Scalp pyoderma involves impetigo-like bacterial infections that result from scratching. In most cases they are caused by streptococci, with some staphylococcal involvement. Scalp pyoderma of this type is closely associated with long-term louse infestation.

Very low-quality evidence Any estimate of effect is very uncertain.

SUBSTANTIVE CHANGES

Isopropyl myristate New option. Categorised as Likely to be beneficial.

Ivermectin (oral) New option. Categorised as Trade off between benefits and harms. Although tested in a clinical trial, oral ivermectin is not currently licensed for treating head lice, and generally its likely usefulness has been superseded by the introduction of physically acting chemicals that will not be affected by resistance and are generally considered safer.

Benzyl alcohol New option. Categorised as Unknown effectiveness as there is insufficient evidence to judge the effects of this intervention.

Spinosad New option. Categorised as Likely to be beneficial.

Dimeticone New evidence added. Categorisation unchanged (Likely to be beneficial).

Herbal treatments New evidence added. Categorisation unchanged (Unknown effectiveness) as there remains insufficient evidence to judge the effects of this intervention.

Malathion New evidence added. Categorisation unchanged (Likely to be beneficial).

Permethrin New evidence added. Categorisation unchanged (Likely to be beneficial).

Pyrethrum New evidence added. Categorisation unchanged (Unknown effectiveness) as there remains insufficient evidence to judge the effects of this intervention.

REFERENCES

1. Williams LK, Reichert A, MacKenzie WR, et al. Lice, nits, and school policy. *Pediatrics* 2001;107:1011–1015.[PubMed]
2. Willems S, Lapeere H, Haedens N, et al. The importance of socio-economic status and individual characteristics on the prevalence of head lice in schoolchildren. *Eur J Dermatol* 2005;15:387–392.[PubMed]
3. Vander Stichele RH, Gyssels L, Bracke C, et al. Wet combing for head lice: feasibility in mass screening, treatment preference and outcome. *J R Soc Med* 2002;95:348–352.[PubMed]
4. Burgess IF. Human lice and their management. *Adv Parasitol* 1995;36:271–342.[PubMed]
5. Gratz NG. Human lice. Their prevalence, control and resistance to insecticides. Geneva: World Health Organization, 1997.
6. Taplin D, Meinking TL. Infestations. In: Schachner LA, Hansen RC, eds. Pediatric dermatology, Vol 2. New York: Churchill Livingstone, 1988:1465–1493.
7. Dodd CS. Interventions for treating head lice. In: The Cochrane Library: Issue 3, 2006. Chichester, UK: John Wiley & Sons, Ltd. Search date 2001.
8. Taplin D, Castillero PM, Spiegel J, et al. Malathion for treatment of *Pediculus humanus* var capitis infestation. *JAMA* 1982;247:3103–3105.[PubMed]
9. Chosidow O, Chastang C, Brue C, et al. Controlled study of malathion and *d*-phenothrin lotions for *Pediculus humanus* var *capitis*-infested schoolchildren. *Lancet* 1994;344:1724–1727.[PubMed]
10. Meinking TL, Vicaria M, Eyerdam DH, et al. Efficacy of a reduced application time of Ovide lotion (0.5% malathion) compared to Nix crème rinse (1% permethrin) for the treatment of head lice. *Pediatr Dermatol* 2004;21:670–674.[PubMed]
11. Meinking TL, Vicaria M, Eyerdam DH, et al. A randomized, investigator-blinded, time-ranging study of the comparative efficacy of 0.5% malathion gel versus Ovide Lotion (0.5% malathion) or Nix Creme Rinse (1% permethrin) used as labeled, for the treatment of head lice. *Pediatr Dermatol* 2007;24:405–411.[PubMed]
12. Roberts RJ, Casey D, Morgan DA, et al. Comparison of wet combing with malathion for treatment of head lice in the UK: a pragmatic randomised controlled trial. *Lancet* 2000;356:540–544.[PubMed]
13. Hill N, Moor G, Cameron MM, et al. Single blind, randomised, comparative study of the Bug Buster kit and over the counter pediculicide treatments against head lice in the United Kingdom. *BMJ* 2005;331:384–387.[PubMed]
14. Burgess IF, Lee PN, Matlock G. Randomised, controlled, assessor blind trial comparing 4% dimeticone lotion with 0.5% malathion liquid for head louse infestation. *PLoS ONE* 2007;2:e1127.[PubMed]
15. Burgess I. Malathion lotions for head lice: a less reliable treatment than commonly believed. *Pharm J* 1991;247:630–632.
16. Burgess IF, Brown CM, Peock S, et al. Head lice resistant to pyrethroid insecticides in Britain. *BMJ* 1995;311:752. [letter]
17. Pollack RJ, Kiszewski A, Armstrong P, et al. Differential permethrin susceptibility of head lice sampled in the United States and Borneo. *Arch Pediatr Adolesc Med* 1999;153:969–973.[PubMed]
18. Lee SH, Yoon KS, Williamson M, et al. Molecular analyses of *kdr*-like resistance in permethrin-resistant strains of head lice, *Pediculus capitis*. *Pestic Biochem Physiol* 2000;66:130–143.
19. Vander Stichele RH, Dezeure EM, Bogaert MG. Systematic review of clinical efficacy of topical treatments for head lice. *BMJ* 1995;311:604–608. Search date 1995.[PubMed]
20. Taplin D, Meinking TL, Castillero PM, et al. Permethrin 1% creme rinse for the treatment of *Pediculus humanus* var capitis infestation. *Pediatric Dermatol* 1986;3:344–348.[PubMed]
21. Hipolito RB, Mallorca FG, Zuniga-Macaraig ZO, et al. Head lice infestation: single drug versus combination therapy with one percent permethrin and trimethoprim/sulfamethoxazole. *Pediatrics* 2001;107:E30.[PubMed]
22. Burgess IF, Brown CM, Lee PN. Treatment of head louse infestation with 4% dimeticone lotion: randomised controlled equivalence trial. *BMJ* 2005;330:1423–1425.[PubMed]
23. Heukelbach J, Pilger D, Oliveira FA, et al. A highly efficacious pediculicide based on dimeticone: randomized observer blinded comparative trial. *BMC Infect Dis* 2008;8:115.[PubMed]
24. Mumcuoglu KY, Miller J, Zamir C, et al. The *in vivo* pediculicidal efficacy of a natural remedy. *Isr Med Assoc J* 2002;4:790–793.[PubMed]
25. Burgess IF, Brunton ER, Burgess NA. Clinical trial showing superiority of a coconut and anise spray over permethrin 0.43% lotion for head louse infestation, ISRCTN96469780. *Eur J Pediatr* 2010;169:55–62.[PubMed]
26. European Parliament. Directive 2003/15/EC of the European Parliament and of the Council of 27 February 2003 amending Council Directive 76/768/EEC on the approximation of the laws of the Member States relating to cosmetic products. 2003. Available at http://ec.europa.eu/consumers/sectors/cosmetics/files/doc/200315/200315_en.pdf (last accessed 24 March 2011).
27. Veal L. The potential effectiveness of essential oils as a treatment for headlice, *Pediculus humanus capitis*. *Complement Ther Nurs Midwifery* 1996;2:97–101.[PubMed]
28. Ginsburg CM, Lowry W. Absorption of gamma benzene hexachloride following application of Kwell shampoo. *Pediatr Dermatol* 1983;1:74–76.[PubMed]
29. Meinking TL, Clineschmidt CM, Chen C, et al. An observer-blinded study of 1% permethrin creme rinse with and without adjunctive combing in patients with head lice. *J Pediatr* 2002;141:665–670.[PubMed]
30. Bainbridge CV, Klein GI, Neibart SI, et al. Comparative study of the clinical effectiveness of a pyrethrin-based pediculicide with combing versus a permethrin-based pediculicide with combing. *Clin Pediatr (Phila)* 1998;37:17–22.[PubMed]
31. Clore ER, Longyear LA. A comparative study of seven pediculicides and their packaged nit combs. *J Pediatr Health Care* 1993;7:55–60.[PubMed]
32. Pasche-Koo F, Claeys M, Hauser C. Contact urticaria with systemic symptoms caused by bovine collagen in hair conditioner. *Am J Contact Dermatol* 1996;7:56–57.[PubMed]
33. Pearlman DL. A simple treatment for head lice: dry-on, suffocation-based pediculicide. *Pediatrics* 2004;114:e275–e279. [PubMed]
34. Korting JC, Pursch EM, Enders F, et al. Allergic contact dermatitis to cocamidopropyl betaine in shampoo. *J Am Acad Dermatol* 1992;27:1013–1015.[PubMed]
35. Niinimaki A, Niinimaki M, Makinen-Kiljunen S, et al. Contact urticaria from protein hydrolysates in hair conditioners. *Allergy* 1998;53:1070–1082.[PubMed]
36. Schalock PC, Storrs FJ, Morrison L. Contact urticaria from panthenol in hair conditioner. *Contact Dermatitis* 2000;43:223.[PubMed]
37. Stadtmauer G, Chandler M. Hair conditioner causes angioedema. *Ann Allergy Asthma Immunol* 1997;78:602.[PubMed]
38. Plastow L, Luthra M, Powell R, et al. Head lice infestation: bug busting vs. traditional treatment. *J Clin Nurs* 2001;10:775–783.[PubMed]
39. Burgess IFL. Randomised, controlled, parallel group clinical trials to evaluate the efficacy of isopropyl myristate/cyclomethicone solution against head lice. *Pharma J* 2008;280:371–375.
40. Kaul N, Palma KG, Silagy SS, et al. North American efficacy and safety of a novel pediculicide rinse, isopropyl myristate 50% (Resultz). *J Cutan Med Surg* 2007;11:161–167.[PubMed]
41. Chosidow O, Giraudeau B, Cottrell J, et al. Oral ivermectin versus malathion lotion for difficult-to-treat head lice. *N Engl J Med* 2010;362:896–905.[PubMed]
42. Meinking TL, Villar ME, Vicaria M, et al. The clinical trials supporting benzyl alcohol lotion 5% (Ulesfia TM): a safe and effective topical treatment for head lice (pediculosis humanus capitis). *Pediatr Dermatol* 2010;27:19–24.[PubMed]
43. Stough D, Shellabarger S, Quiring J, et al. Efficacy and safety of spinosad and permethrin creme rinses for pediculosis capitis (head lice). *Pediatrics* 2009;124:e389–e395.[PubMed]

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Competing interests: IB is the lead and co-author of a number of RCTs in this review, some of which were industry sponsored. IB has been a consultant to various makers of pharmaceutical products, alternative therapies, and combs for treating head louse infections.

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GRADE **Evaluation of interventions for Head lice.**

Important outcomes					Eradication rate				
Studies (Participants)	Outcome	Comparison	Type of evidence	Quality	Consistency	Directness	Effect size	GRADE	Comment
What are the effects of treatments for head lice?									
1 (119) [8]	Eradication rate	Malathion versus placebo	4	–1	0	–1	0	Low	Quality point deducted for sparse data. Directness point deducted for short follow-up (7 days)
1 (193) [9]	Eradication rate	Malathion versus phenothrin	4	–2	0	–1	0	Very low	Quality points deducted for sparse data and potential confounding of results because of parental non-compliance. Directness point deducted for short-term follow-up
2 (238) [10] [11]	Eradication rate	Malathion versus permethrin	4	–1	0	–1	0	Low	Quality point deducted for different time periods of agent versus single dose of another agent. Directness point deducted for restricted study population (isolated community exposed to agricultural pesticides)
1 (72) [12]	Eradication rate	Malathion versus mechanical removal of lice	4	–1	0	0	+1	High	Quality point deducted for sparse data. Effect-size point added for RR >2
1 (133) [13]	Eradication rate	Malathion or permethrin versus mechanical eradication	4	–2	0	–1	0	Very low	Quality points deducted for sparse data and inadequate length of follow-up for 1 group. Directness point deducted for use of non-standard doses
1 (73) [14]	Eradication rate	Malathion versus dimeticone	4	–1	0	0	0	Moderate	Quality point deducted for sparse data
7 (726) [19]	Eradication rate	Permethrin versus lindane	4	–1	0	0	0	Moderate	Quality point deducted for incomplete reporting of results
1 (63) [20]	Eradication rate	Permethrin versus placebo	4	–1	0	0	0	Moderate	Quality point deducted for sparse data
1 (115) [21]	Eradication rate	Trimethoprim–sulfamethoxazole (TMP-SMX, co-trimoxazole; oral) versus permethrin	4	–2	0	–1	0	Very low	Quality points deducted for sparse data and poor quality of follow-up. Directness point deducted for inclusion of other intervention, non-identical comparators, and non-standard doses
1 (115) [21]	Eradication rate	Trimethoprim–sulfamethoxazole (TMP-SMX, co-trimoxazole; oral) plus permethrin versus permethrin alone	4	–2	0	–1	0	Very low	Quality points deducted for sparse data and poor quality of follow-up. Directness point deducted for inclusion of other intervention, non-identical comparators, and non-standard doses
1 (253) [22]	Eradication rate	Dimeticone versus phenothrin	4	0	0	–1	0	Moderate	Directness point deducted for uncertain generalisability of intervention
1 (145) [23]	Eradication rate	Dimeticone versus permethrin	4	–2	0	0	0	Low	Quality points deducted for sparse data and for early termination of RCT at 9 days
1 (143) [24]	Eradication rate	Herbal and essential oils versus combined insecticides	4	–2	0	–1	0	Very low	Quality points deducted for sparse data and failure to explain high withdrawal rate. Directness point deducted for uncertain generalisability of herbal product outcome
1 (100) [25]	Eradication rate	Herbal and essential oils versus permethrin	4	–1	0	–1	0	Low	Quality point deducted for sparse data. Directness point deducted for unclear generalisability of the single specific herbal product
1 (95) [29]	Eradication rate	Combing plus insecticide versus insecticide alone	4	–1	0	–1	0	Low	Quality point deducted for sparse data. Directness point deducted for uncertain generalisability of results.
1 (30) [38]	Eradication rate	Phenothrin versus mechanical removal of lice	4	–2	0	–1	0	Very low	Quality points deducted for sparse data and different follow-up for different groups. Directness point deducted for uncertain generalisability of intervention

Important outcomes			Eradication rate						
Studies (Participants)	**Outcome**	**Comparison**	**Type of evidence**	**Quality**	**Consistency**	**Directness**	**Effect size**	**GRADE**	**Comment**
1 (168) [39]	Eradication rate	Isopropyl myristate versus permethrin	4	–1	0	–1	0	Low	Quality point deducted for sparse data. Directness point deducted for early termination of 1 RCT
1 (60) [40]	Eradication rate	Isopropyl myristate versus pyrethrum	4	–2	0	0	0	Low	Quality points deducted for sparse data and incomplete reporting of results
1 (812) [41]	Eradication rate	Oral ivermectin versus malathion lotion	4	0	0	–1	0	Moderate	Directness point deducted for restricted population (only in people with failed insecticide treatment or a household contact with failed insecticide treatment) affecting generalisability beyond this group
2 (250) [42]	Eradication rate	Benzyl alcohol versus placebo	4	–1	0	0	0	Moderate	Quality point deducted for incomplete reporting of results
1 (347) [43]	Eradication rate	Spinosad versus permethrin	4	–2	0	0	0	Low	Quality points deducted for incomplete reporting of results (percentages only) and no efficacy results for one arm of trial

We initially allocate 4 points to evidence from RCTs, and 2 points to evidence from observational studies. To attain the final GRADE score for a given comparison, points are deducted or added from this initial score based on preset criteria relating to the categories of quality, directness, consistency, and effect size. Quality: based on issues affecting methodological rigour (e.g., incomplete reporting of results, quasi-randomisation, sparse data [<200 people in the analysis]). Consistency: based on similarity of results across studies. Directness: based on generalisability of population or outcomes. Effect size: based on magnitude of effect as measured by statistics such as relative risk, odds ratio, or hazard ratio.