

Head lice on pillows, and strategies to make a small risk even less

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Abstract

Background Due to a lack of evidence, controversy exists about the role of bedding in the transmission of head lice.

Aims To determine the proportion of the head lice population found on pillowcases of people with head lice, and to test strategies available to householders to kill head lice on pillowcases.

Methods To assess the incidence of head lice on pillowcases, people with active pediculosis had their head lice collected and counted and the pillowcase they had used the night before examined for head lice. To test strategies to kill head lice on pillowcases, live head lice were experimentally placed in miniature pillowcases, and the cases were subjected to a hot wash, a cold wash, hot dryer, and hanging out to dry on an outdoor clothes line.

Results Forty-eight people and their pillowcases were recruited from Townsville, Qld, Australia (dry tropics). One thousand, eight hundred and forty-five lice were collected from their heads to give an average and median intensity of infection of 38.4 and 21 lice, respectively. Two of the 48 pillowcases contained live lice, one nymph on each, 2 h and 9 h after the pillowcases had been removed from the bed. Another pillowcase contained a dehydrated nymph. The incidence of live lice on pillowcases was 4.2% per night and the proportion of the head louse population on the pillowcases was 0.11%. Heat (hot wash and hot clothes dryer) killed head lice experimentally placed in pillowcases. Cold wash and hanging pillowcases out to dry did not kill head lice.

Conclusions Head lice transfer to pillowcases at night, but the incidence is low. Pillowcases pose a risk for re-infection with head lice, but the risk is low, and changing the pillowcase is a reasonably cost-efficient strategy to minimize this risk. Lice on pillowcases can be killed by heating the pillowcase by immersion in water at > 60 °C, by a hot wash, or by 15 min in a hot clothes dryer.

Introduction

Re-infection is a common problem in the control of pediculosis due to *Pediculus humanus* var *capitis*. The main route of transmission appears to be by head-to-head contact and, although there is no experimental evidence of this, the point is rarely disputed.^{1,2} The role of other routes of transmission, however, is more controversial, with some authors proposing that these events are rare,¹ and others stating that fomite transmission is common.^{3,4} Official advice for the control of head lice frequently includes recommendations to treat bedding, soft toys, and clothes, and to clean the household environment.⁵ The published data on the occurrence of head lice off the head is scanty, and no studies have been performed on the viability of head lice found off the head. Head lice found on furnishings have been proposed as dead, sick, senile, or injured.⁶ One author noted active head lice on pillows in

Bangladesh.² Examination of carpets during daylight hours on classroom floors in primary schools and day care centres in Townsville found no lice, whereas 14,033 lice were found on the heads of children using these classrooms.⁷ Some have argued that the behavior of head lice may vary with climate, and be different between the tropics and temperate zones.⁸ Pubic lice, *Phthirus pubis*, are more active at night,⁹ but no data exist on the circadian activity of head lice.

This study looked for and found live head lice on the pillows of people from tropical Australia with active pediculosis, and investigated practical strategies that could be used by the general public to kill head lice on pillows.

Methods

Survey of people with pediculosis and their pillowcases

Lice were removed from the hair of 48 people in Townsville, Qld,

Australia (dry tropics) with active pediculosis by combing with a fine tooth comb after the application of hair conditioner or Lice Blaster (Emerald Forest Pharmaceuticals Pty Ltd., Currumbin, Queensland, Australia). The product and lice were wiped onto paper tissue, the lice were detected using a dissecting microscope and classified into adult (male/female) and nymphs, and each category was counted and recorded.

Prior to examination for head lice, each subject or their guardian placed the pillowcase from the bed in which the subject had slept into a plastic bag, sealed it, and recorded the time. On the same day, at the time of collection of lice from the head of each subject, the pillowcase was examined for lice with transmitted and incident light using a dissecting microscope. Any lice found were collected using jeweler's forceps and the life cycle stage was identified.

The viability of lice from pillowcases or after experimental procedures was assessed by observation of activity in every case and, for some lice, by the ability to feed from the dorsum of the hand of a human volunteer within 6 h of collection.

Experiments to kill lice on pillowcases

Lice for experiments were collected by dry combing from active cases of pediculosis. The lice were placed on hairs in a plastic Petri dish and the dish was sealed with Parafilm (American National Can, Neenah, WI, USA) and stored at room temperature in a sealed plastic container containing a moistened paper pad. If lice were not used for experiments within 6 h, they were fed on the back of a hand of a volunteer and used after feeding. Only lice that were active and nondehydrated were used. For the experiments described below, miniature pillowcases made of unbleached calico and measuring 10 cm square were stitched on three sides. Lice were placed into the case and the fourth side was stitched to seal the mini-pillowcase. The mini-pillowcase and contained lice were then subjected to the experimental procedure. When the procedure was completed, the pillowcase was cut open along three sides, and the lice were collected and examined using a dissecting microscope. The temperature was measured using an electronic probe.

Hot clothes dryer

A test group of two females and 10 nymphs in a mini-pillowcase was placed in an empty clothes dryer for 15 min (70 °C). A control group of one female and 10 nymphs was held in a mini-pillowcase at room temperature (26 °C). A second test group of one female, three males, and three nymphs in a mini-pillowcase was placed in a dryer full of dry sheets and pillowcases for 15 min (68 °C). A control group of one female and four nymphs was held at room temperature (29 °C).

Cold wash

A test group of 10 nymphs in a mini-pillowcase was placed in a washing machine with a full load of household laundry using washing powder on an automatic cold washing cycle. A control

group of 10 nymphs was held in a mini-pillowcase at room temperature (27 °C).

Hot wash

A test group of six nymphs in a mini-pillowcase was placed in a washing machine with a full load of household laundry using washing powder on an automatic hot wash/cold rinse cycle. A control group of six nymphs was held in a mini-pillowcase at room temperature (27 °C).

Drying outside at Townsville, Qld, Australia (cloudy day)

A test group of eight nymphs in a mini-pillowcase was soaked in water and placed on an outside clothes line to dry on a cloudy day (29 °C) with intermittent sunlight and a moderate breeze. A control group of seven nymphs was held indoors in a similarly treated mini-pillowcase at room temperature (27 °C). The mini-pillowcases were left on the line until they were dry to the touch.

Drying outside at Townsville, Qld, Australia (cloud-free day)

A test group of 10 nymphs in a mini-pillowcase was soaked in water and placed on an outside clothes line to dry on a cloud-free afternoon (31 °C) with a slight breeze. A control group of five nymphs was held indoors in a similarly treated mini-pillowcase at room temperature (25 °C). The mini-pillowcases were left on the line until they were dry to the touch.

Results

Survey of people with pediculosis and their pillowcases

The 48 cases of active pediculosis recruited consisted of seven males and 41 females. Most were children aged between 3 and 17 years (mean, 9.15 years); one subject was an adult female. The number of lice recovered from the 48 heads was 1845, consisting of 335 adults (158 male lice and 177 female lice) and 1510 nymphs, with an average and median intensity of infection of 38.4 and 21 lice per head, respectively, and a range of 1–416 lice. Examinations of pillowcases were carried out between 2 and 11 h after rising (average, 6.33 h). Of the 48 pillowcases examined, two live lice were found on two pillowcases, a prevalence of 4.2%. Both were nymphs. On another pillowcase, the carcass of a dead nymph was found with dehydration to such an extent that it had probably been dead for a minimum of 24 h or greater. Of the total population of 1847 head lice found on heads and pillowcases, the proportion on pillowcases was 0.11%. Of the two lice found on pillowcases, both were active and able to walk, 2 h and 9 h after the cases had been collected. The children using these pillowcases had 17 and 41 lice each on their heads. One nymph was allowed to feed within 12 h and fed quickly (< 10 min). This louse was maintained by 12-h feeding for an additional 2 days. Moulting occurred 36 h after collection.

Experiments to kill lice on pillowcases

Dryer for 15 min

All test lice from both experiments (empty and full dryer) were dead after 15 min. The bodies of the lice were collapsed, consistent with severe dehydration. All control lice were active and alive, and their bodies appeared normal.

Cold wash

All test lice were alive and active after the washing cycle had finished (duration, 55 min). All control lice were alive and active after this time.

Hot wash

All test lice were dead, whereas all control lice were alive. The bodies of the test lice were a homogeneous brown, but they were not collapsed like the test lice put in the dryer. The water temperature during the hot wash was 66 °C.

Drying outdoors (cloudy day)

After 2 h on the line, the test mini-pillowcase was dry to the touch, whilst the control one indoors was still damp. All lice were alive and active in both test and control mini-pillowcases. All test lice fed readily.

Drying outdoors (cloud-free day)

After 3 h on the line in full sun, the test mini-pillowcase was dry to the touch, whilst the control one indoors was still damp. All lice were alive and active, and all fed.

Discussion

This study has shown that head lice move from the hair of the head to pillowcases whilst humans are sleeping during the night. The two lice recovered from the pillowcases within 9 h of the subjects rising from the bed were viable and capable of re-establishing on a head. The chance of lice being found on the pillowcase in the morning was, however, small (4.2%), and the number of lice found on the pillowcases was a very small percentage of the total head louse population on heads and pillowcases (0.11%).

This is the first evidence found that head lice transfer to bedding at night. Pubic lice are more active at night than during the day,⁹ but the daily cycle of activity of head lice has not been studied. The implications for the control of head lice is that, as the pillow of a person with active pediculosis may contain small numbers of lice, management of pillowcases and possibly sheets and other bedding should be considered in a treatment regime. As the frequency of head lice on pillowcases was low and the number of lice found was small, however, effort spent on other items of bedding may have minimal return, as we would expect the highest density of head lice to be on the pillowcase. The major focus of control activities

should be to reduce the number of lice on the head and to lessen the risks of head-to-head contact.

A household clothes dryer for 15 min killed all head lice in the mini-pillowcase. Dehydration occurred, but heat per se may be the major lethal process as the temperature in the outlet of the drier was at least 70 °C. Washing on a hot wash/cold rinse cycle at a temperature of 66 °C killed all lice. These lice were not dehydrated, and had been killed by the heat. Hot water at 60 °C kills head lice in 10 s.¹⁰ Cold washing in an automatic washing machine did not kill head lice. Washing lice in a mini-pillowcase and then drying it on a clothes line outdoors on a cloudy day at a maximum temperature of 29 °C or a cloud-free day in full sun at 31 °C also did not kill head lice.

Recommendations

When pediculosis is treated, strategies to kill head lice on pillowcases should also be considered. As the chances of lice being found on pillowcases is low, the low risk of transmission that this represents must be considered in a cost-benefit assessment. A reasonable strategy is that a clean pillowcase should be used once the person has been treated. To kill head lice on pillowcases, the effective control strategies involve the use of heat at greater than 60 °C, and can include placing pillowcases in a clothes dryer on a hot cycle for 15 min, washing in hot water in an automatic washing machine, or immersing in hot water at a temperature of 60 °C or greater. Drying clothes on an outdoor line and washing in cold water are not effective strategies. Use of insecticidal solutions on items such as bedding is unnecessary, as effective physical methods are easily available and insecticidal solutions on environmental items are not recommended for head lice control.¹¹ Insecticidal products commercially available for this purpose should be removed from the market as they do not have a role in head lice control, and they pose a theoretical risk of accidental poisoning. This study reinforces the message that the major focus to prevent re-infection should be to reduce the occurrence of hair-to-hair contact with infected people.

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