

Efficacy of Machine Laundering to Eradicate Head Lice: Recommendations to Decontaminate Washable Clothes, Linens, and Fomites

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The efficacy of machine laundering to eradicate head lice should be determined. Viable lice and nits were machine laundered using 3 washing programs (with water temperatures of 40°C, 50°C, and 60°C), with and without detergent, and the results were compared with results for control lice and nits. A drying program was also used. Either washing done with a water temperature of at least 50°C or drying is necessary to kill head lice and nits.

Management of head lice classically includes decontamination of potentially contaminated clothes, linens, and fomites [1, 2]. The only study to suggest the efficacy of machine laundering for the elimination of organisms (e.g., body lice) did not specify the water temperature that should be used [3]. The Centers for Disease Control and Prevention's fact sheet devoted to the topic of head lice infestation recommends machine laundering with a hot-water cycle (water temperature, 54.5°C) and/or dry laundering with high heat for at least 20 min, but no hard data are available to support these recommendations [4]. The aim of the present study was to evaluate the efficacy of machine laundering to eradicate head lice contaminating clothes and/or linens, by use of different wash-cycle durations and water temperatures, with and without laundry detergent, as well as by drying.

The study was conducted in September and October 2003.

Approximately 800 students from 5 elementary schools were examined during a head lice detection program; the examinations were conducted with the approval of the school directors and in collaboration with school medical officers. All the students in a given school were examined the same day. The students were inspected for the presence of both live lice and nits (located close to the hair roots). Students with head lice had their hair combed with a special fine-tooth comb while they leaned over a smooth white surface. Lice and nits that fell on this surface were collected, placed into petri dishes (diameter, 85 mm), and sent to the laboratory, where they were observed using a binocular microscope, as described elsewhere [5].

Only viable lice were counted before being placed in tightly knit mousseline pouches that were each carefully tied shut with a string; each of the pouches, in turn, was placed in a second identical pouch, which was also tied shut with a string. The same procedure was followed for nits. The pouches were then placed in the drum of a Whirlpool washing machine (model AWM 8120), with or without laundry detergent (Dash 3; Procter & Gamble). Three different washing programs were selected (program water temperature and cycle duration: 40°C for 1 h and 15 min, 50°C for 1 h and 15 min, and 60°C for 1 h and 10 min), and each program was tested with and without detergent. When possible, controlling for the water temperature indicated on the digital screen of the washing machine was done by placing a minimum-maximum thermometer in the drum of the machine. Each doubled pouch was washed only once, and, for each load washed, one pouch each of control lice or nits was set aside and kept at room temperature.

After the experiment, the pouches were opened, and their contents were observed under the same microscope. Viable and dead lice were counted separately. Nits were placed in incubators for a maximum of 12 days, and their viability was assessed daily. Samples of lice and nits that had not been washed first were also placed in a Whirlpool dryer (model AWZ 899) for 40 min (with the air temperature inside the dryer reaching 100°C–130°C, according to the manufacturer) and were subjected to the same counting procedures described above. Comparisons of findings were done using the χ^2 test.

Table 1 shows the numbers of viable and dead lice, as well as the numbers of hatched and dead nits, after machine laundering was performed at a water temperature of 40°C, with or without detergent, compared with the numbers of viable control lice or nits. Notably, all lice died after machine laundering was performed, with or without detergent, at a water temperature of 50°C ($n = 99$) or 60°C ($n = 185$), whereas 32 of 33

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Table 1. Status of lice and nits after machine laundering performed at a water temperature of 40°C.

Laundering condition	Lice				Nits			
	No. evaluated	Viable, no. (%)	Dead, no. (%)	<i>P</i>	No. evaluated	Viable, no. (%)	Dead, no. (%)	<i>P</i>
No detergent	122	115 (94.3)	7 (5.7)	NS	38	30 (79.0)	8 (21.0)	NS
With detergent	215	165 (76.7)	50 (23.3)	<.0001	35	31 (88.6)	4 (11.4)	NS
Control	119	117 (98.3)	2 (1.7)	...	63	58 (92.0)	5 (8.0)	...

NOTE. NS, not significant.

control lice and 75 of 75 control lice set aside for comparison with lice subjected to these washing programs, respectively, remained viable ($P < .0001$). Similarly, all the nits were dead and did not give rise to larvae when they were subjected to machine laundering, with or without detergent, at water temperatures of 50°C ($n = 41$) and 60°C ($n = 40$), compared with controls (respectively, 38 of 40 control nits and 20 of 20 control nits set aside for comparison with nits subjected to these washing programs were viable and hatched larvae; $P < .0001$). Drying produced similar results (not shown).

Only machine laundering performed at a water temperature of at least 50°C, with or without detergent, or drying performed for 40 min ensures that fabrics can be effectively decontaminated after lice and nit infestation, when lice and nits that were machine washed or dried were compared with control lice and nits that had not undergone washing and/or drying. Indeed, a mortality rate of 100% for lice and nits is required. One limit of the present study is that the water temperature within a washing machine (or the air temperature within a dryer) that is full of laundry can be different from the temperature that occurs when the drum contains a sparse load. One can only hypothesize that, if a difference exists, then the temperature should be slightly higher when the drum is empty.

Although major efforts to reduce the transmission of lice and nits via clothes, linen, and fomites have not been proven necessary to eradicate infestation [6], it cannot be totally excluded that the absence of such efforts is a source of reinfestation and is able to explain therapeutic failure with regard to head lice [1]. The Centers for Disease Control and Prevention

recommends machine laundering of all washable clothing and bed linens worn or used by a lice- and/or nit-infested person during the 2 days before treatment [4]. Finally, although the incidence is low, the transfer of head lice to pillowcases has been demonstrated [7]. When environmental measures are warranted, we recommend that machine laundering be performed at a water temperature of at least 50°C to decontaminate washable clothes, linen, and fomites. Simply placing potentially infested items (e.g., toys) in a dryer could also be a way to kill lice and/or nits.

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