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**Brief communication (Original)**

# Controlling head lice in Iranian primary schools for girls

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***Background:*** In spite of large budgets for procurement and distribution of pediculicide shampoos, prevalence of pediculosis in girls' primary schools continues.
***Objective:*** To study the efficacy of the pediculicide shampoos lindane 1% and permethrin 1%, for pediculosis control among students.
***Methods:*** One thousand forty two louse-infested schoolgirls in 31 girls' primary schools were randomly treated with the shampoos (520 students with lindane 1% and 722 students with permethrin 1%). One hundred twenty five contaminated schoolgirls were treated with placebo shampoos. Efficacy of shampoos was studied after using twice with a one week interval. At the start, an educational pamphlet was distributed among all students discussing methods of prevention and directions for use of shampoos.
***Results:*** We found that shampoo treatment resulted in only 52.9% overall recovery. With lindane, it was 50.96% and with permethrin 54.29%. The highest level of recovery was observed among primary school girls in grade five. Recovery in the central zone of the city and in private schools was better. Furthermore, the efficacy level of the shampoos was influenced by different factors such as parasite load, type of school, school location, level of education, level of awareness, and sociocultural factors.
***Conclusion:*** Pediculicide shampoos are effective, but education and modification of sociocultural factors are also important.

***Keywords:*** Lindane shampoo, pediculicide, pediculosis, permethrin shampoo

Head louse infestation is still common in parts of Iran. Although the prevalence of pediculosis has decreased significantly, infestation is still seen. The effectiveness of a pediculicide in field situations differs greatly. The use of lindane 1% in 265 contaminated school children in the Hamedan township (Iran) led to 72% recovery after two weeks of treatment [1]. Evaluation of Gamma-benzene shampoo in 150 contaminated schoolchildren in Arak city showed 74.66% recovery [2]. In Taiwan, the effect of four pediculicides in 1657 contaminated cases showed 81%, 78%, 64%, and 72% recovery for permethrin cream 1%, bioallethrin aerosol, malathion shampoo 1%, and gamma-benzene hexachloride shampoo 1%, respectively [3]. The results of malathion 0.5% and gamma-benzene 0.5% treatment on infested persons in Malaysia resulted in 100% recovery [4]. Studies show that the effect of most toxins on in vitro lice differs from results in vivo. However, collective, complete, and simultaneous treatments have led to a significant decrease in the prevalence of lice infestation. These need to focus on transmission between family members and friends. In addition, educational criteria, prompt identification of contaminated individuals, access to appropriate water sources and cooperation by parents and teachers have an important role in control [5, 6]. Nevertheless, we find that, in spite of a huge annual budget, lice infestation is still prevalent in many cities of Iran [7]. Selecting insecticide formulations depends upon availability of specific products, the patient preference, cost, and efficacy. Although visible products are more effective, most subjects do not like them because they identify the contaminated individual. Shampoo formulations for treatment of head lice are more attractive and are preferred by patients and parents [8]. Furthermore, shampoos show greater ovicidal efficacy than lotions [9]. Insecticides for control of head lice include gamma-benzene hexachloride, permethrin, malathion, propoxur, and gamma-HCH (lindane) [10].

Lindane is an organochlorine insecticide that has a dermal toxicity at $LD_{50}$ = 900–1000 mg/kg. Permethrin is an insecticide in the synthetic pyrethroids group and is less stable in comparison to lindane, but is stable in comparison to pyrethrin (natural

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pyrethroid). Permethrin kills the adult louse, the nit, and the larvae and has some repellent property. Its toxicity is $LD_{50}$ = 2000 mg/kg, less than lindane. Lindane is not effective on nits. It is an effective compound to eradicate head lice. Treatment with any shampoo requires repeating application after one week to kill nits [10, 12]. Resistance to lindane is being reported [12]. In 1988, Dinapoli compared treatment efficacy of permethrin cream 1% with Rid on 435 head louse contaminated subjects and obtained a results of 98% recovery using permethrin and 85% using Rid [13]. The active ingredients for Rid are pyrethrum extract and piperonyl butoxide. In 1992, Ree et al. [14] performed a study in Korea on mass treatment of school children using Sumithrin (0.4% phenothrin) powder. In the 2,515 cases, louse contamination was 38.6%. With Sumithrin powder, reduction of head louse contamination was 93.3%. A previous study [12] found that the effectiveness of permethrin cream 1% in treatment of head lice was 99%, and compared results with placebo and lindane shampoo. Two weeks later, 99%, 43%, and 43% recovery was recorded for permethrin, lindane, and placebo shampoos. Permethrin was considered superior. One thousand five hundred sixteen children near Jerusalem were studied and a reduction of permethrin efficacy was observed. [15]. A study of 2,288 school and kindergarten children with head lice in Korea found that 3.9% boys and 23.5% girls (246/1026) were contaminated with nits or lice. After once or twice use of gamma-benzene hexachloride shampoo 1%, recovery was 93.5% [16]. Efforts at control of head lice in children must focus on elimination of nits and adult lice, and elimination of the reservoir for reinfection [17]. The highest level of contamination was in schools for girls (21.8%) and transmission was observed in all schools of Yasuj city in a previous study [7]. Our study was conducted with the objective of determining an acceptable and effective control method and identification of potential barrier to success.

## Materials and methods

We studied 1,242 louse infested primary school girls at Yasuj, Iran who were identified among 5,809 female schoolchildren in 31 female primary schools. They were exposed to pediculicide shampoos. A control group of 125 girls from five primary levels was treated with placebo shampoos. The study was approved by our institutional Review Board. General instruction was provided by an educational pamphlet discussing diagnosis, importance, control, and prevention of pediculosis, described in simple language. The pamphlet was distributed to all students.

The shampoos included lindane 1% (in a 600 mL tube, manufactured by Gilaranco, Rasht, Iran) and permethrin shampoo 1% (in a 100 mL tube containing permethrin 1% and piperonyl butoxide 1% manufactured by Fore Co, Parma, Italy). Five hundred twenty contaminated girls were given lindane shampoo 1% and 722 girls were given permethrin shampoo 1%. There was no limitation in the number of units to family members of contaminated individuals. All subjects were encouraged to apply the shampoo for five minutes on the head once, and repeat this after one week. Ten days after the first application of shampoo, the individuals were examined. Presence of nits or adult lice was considered as infestation. Infested individuals were treated. The study schools were located in three socioeconomically different districts of the city. District 1 comprised of a high number of new and expensive buildings. Whereas district 3 includes old and inexpensive buildings. In district 2 the buildings were of median value. Normality of data and homogeneity of variances was detected by using exploratory and Levene's tests (SPSS software, ver. 19.0). Data were analyzed using an ANOVA and *t* test.

## Results

One thousand two hundred forty two louse-infested girls were provided pediculicides or placebo shampoos combined with an educational program. Fifty-two point nine percent were found free of lice. Results are shown in **Table 1**. One hundred twenty

**Table 1.** Recovery of pediculosis cases among Yasuj female primary school students

| Type of pediculicideshampoo | Contaminated cases (n) | Recovered cases (n) | Percentage of recovery |
|---|---|---|---|
| Lindane 1% | 520 | 265 | 50.96 |
| Permethrin 1% | 722 | 392 | 54.29 |

five infested girls were located in placebo group. All girls in placebo group remained infested at the end of study (**Table 2**). Recovery with permethrin shampoo was 54.29% and with lindane shampoo was 50.96%. **Table 2** shows recovery in relation to class/grade. The highest percentage of recovery was observed in grade 5 children ($p > 0.05$). However the recoveries between grades was not significant (CI = 95%). Moreover, there were no significant differences between percentage recoveries of two treatment shampoos based on confidence interval 95%.

The obtained results of recovery level arising from the effects of pediculicide shampoos in three given zones of Yasuj city are shown in **Table 3**. It shows that the most recovery (in total) was in district 1 (central of the city with the highest socio economic level). Recoveries by shampoos whether from private or government affiliated schools were observed 80.95 and 52.42% respectively.

## Discussion and conclusions

Our results show a 52.9% decline in pediculosis cases following the use of pediculicide shampoos. Permethrin shampoo produced a 54.21% recovery and lindane shampoo a 50.96% recovery. This is in the range of reports by Budak et al. (67.5% with lindane shampoo) [18], Stough et al. (44.9% using permethrin 1% with combing) [19], Khazaie (72.62% using gamma-benzene hexachloride shampoo) [2], Ha et al. (93.5% using lindane shampoo) [16], Dinapoli et al. (98%) [13], Brandenburg (43% using lindane shampoo) [12], and Fan et al. (71% using gamma-benzene shampoo) [20]. In comparison we see that in the studies conducted by others, the level of recovery using pediculicide shampoos are often more than ours and more than 90% recovery was seen. Explanation for this is complex. Inappropriate application of shampoos is one possibility as the treatment was unsupervised by the investigators. The highest level of recovery was seen among the schools with the highest-grade level (five), which also had the highest level of infestation.

This could be the result of a perception of the need to succeed in eradicating the large load of lice by using the shampoo energetically and as instructed. While at the lower grades and age groups, proper understanding of the instruction and less motivation may have played a role. A high frequency of contamination in the studied girl's schools increases the probability of further contamination because of

**Table 2.** Recovery of pediculosis cases with regard to type of agents used and grade level of children studied

| Primary education grades | Witness | | Effect of total pediculicide shampoos | | Effect of permethrin shampoo 1% | | Effect of lindane shampoo | |
|---|---|---|---|---|---|---|---|---|
| | Recovery | Contaminated cases exposed | No. recovered cases (% recover) | Contaminated cases exposed | No. recovered cases (% recover) | Contaminated cases exposed | No. recovered cases (% recover) | Contaminated cases exposed |
| First | 0 | 25 | 92 (54.1%) | 170 | 49 (53%) | 91 | 43 (54.4%) | 79 |
| Second | 0 | 25 | 108 (51.7%) | 209 | 69 (56.1) | 123 | 39 (45.4%) | 86 |
| Third | 0 | 25 | 124 (48.4%) | 256 | 71 (50%) | 142 | 53 (46.5%) | 114 |
| Fourth | 0 | 25 | 160 (53.5%) | 299 | 100(53.8%) | 186 | 60 (53.1%) | 113 |
| Fifth | 0 | 25 | 173 (56.2%) | 308 | 103 (57.2%) | 180 | 70 (54.7%) | 128 |
| Total | 0 | 125 | 657 (52.9%) | 1242 | 392 (54.3%) | 722 | 265 (50.6%) | 520 |

**Table 3.** Recovery of pediculosis cases using permethrin or lindane combined with an education programme

| Given districts* | Effects of lindane shampoo1% | | | Effects of permethrin shampoo 1% | | | Total effects |
|---|---|---|---|---|---|---|---|
| | Contaminated | Recovery | % | Contaminate | Recovery | % | % recovery |
| District 1 | 87 | 55 | 63.22 | 114 | 60 | 52.63 | 57.21 |
| District 2 | 76 | 44 | 57.89 | 254 | 130 | 51.18 | 52.72 |
| District 3 | 357 | 166 | 46.5 | 254 | 202 | 57.06 | 51.76 |

* District 1 located socioeconomically greater than district 2 and district 2 greater than district 3. Between education grades using an ANOVA test, $F_{2,128} = 0.736$, $p = 0.481$

carelessness of some in timely, simultaneous, and proper treatment. There were schools that had 100% recovery (two schools), but also less than 30% in three schools [21]. The success rate of the type of school (governmental or private), cognitive educational patterns, and sufficient budget of families (could be seen in districts) play a large role in efficacy of shampoos [5, 6]. In the central district (district 1) there was access to_sufficient water and a relatively desirable living standard, which was a probable factor in the decline in the level of contamination [5, 6]. The role of other factors such as active support by the family members are equally important and should be addressed in future studies.

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