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Report

Head lice infestations in rural Honduras: the need for an integrated approach to control neglected tropical diseases

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Abstract

Background Pediculosis capitis is a neglected tropical disease (NTD) that receives little attention in countries where it continues to be endemic. This study aimed to understand the impact of *Pediculus humanus capitis* infestations in the lives of Honduran children living in extreme poverty.

Methods A qualitative study on head lice infestation was conducted in June 2016 in a rural community in Honduras. Parents were invited to bring their children for head lice inspection using a dry-combing technique with a stainless steel-toothed comb with suction power. A semistructured questionnaire was administered to participants. Questions were broadly grouped into knowledge about transmission, control practices, barriers to treatment, and the overall impact of these infestations in children's wellbeing. Responses were coded, categorized, and organized through a theme-based approach.

Results In total, 52 children aged 2–14 years (42 girls) and their mothers were enrolled in the study. The overall proportion of children with an infestation was 83%. Response analysis revealed a lack of understanding regarding lice transmission and stigmatization of infested children and the widespread belief that head lice were acquired during bathing in the slow-flowing river running through the village. An agricultural plaguicide was commonly used to rid children of head lice.

Conclusions The study underscores the dire situation of the rural poor, their physical and mental health affected by pediculosis capitis as well as other NTDs. These results highlight the need to reassess approaches and action towards combating NTDS under an integrated framework.

Introduction

The World Health Organization has recently included scabies and other ectoparasitoses on the neglected tropical diseases (NTDs) priority list.[1] Pediculosis capitis is one such ectoparasitosis. The infestation is caused by *Pediculus humanus capitis*, an obligatory blood-sucking louse that colonizes the human scalp to feed and reproduce.[2] Head lice commonly infect children under 15 years of age and are widely transmitted in school settings, principally due to direct head-to-head contact and sharing of clothing items. Adult and nymphs do not live off the host for long, with reports ranging from a few hours or a little over a day, to up to 4 days under favorable conditions.[3] Transmission through infected fomites such as pillowcases, upholstery, bedding, combs, and clothing has been suggested although remains controversial.[3] Risk factors associated with head lice infestations include gender (predominant in girls), overcrowding, and a low ratio of beds per person.[4] Persistent head lice infestations can cause severe itching, sleep interruptions, disturbances in concentration, secondary bacterial infections, impetigo, and cervical lymphadenopathy.[3,5] Furthermore, open wounds propagated by pediculosis capitis infections can provide the fly *Cochliomyia hominovorax* with a gateway to deposit their eggs onto the skin, resulting in myiasis infections.[6,7] Pediculosis capitis infestations have also been linked with scabies.[8]

Along with other ectoparasites, *P. h. capitis* infestations are normally overlooked by health authorities and primary health-care providers. However, *P. h. capitis* is becoming a significant concern because of the increasing worldwide prevalence and extensive resistance to treatment.[9,10] Studies reporting bacterial pathogens in head lice specimens have recently added to these concerns. However, the role of *P. h. capitis* as a potential infectious disease vector is still uncertain.

In addition to their biomedical and clinical consequences, it is well known that head lice infestations cause children to experience social stigma, anxiety, and isolation.[11]

Head lice infestations are prevalent in both industrialized and developing countries; however, the distribution of head lice is uneven among the population.[5] Infestations can appear sporadically in distinct socioeconomic population groups. In contrast, at-risk populations are not only subject to endemic transmission but to epidemics as well. Most at risk include schoolchildren, those who are homeless, refugees, and those residing in resource-poor communities.[5] In the Americas, pediculosis is well documented in South American countries.[12] Prevalence data are readily found in the literature for these countries: Brazil (13–38%),[12,13] Peru (19.9%),[14] Venezuela (25.1–28.8%),[15,16]Argentina (61.4 and 29.7%),[17,18] and Colombia (11.5%).[19] In contrast with availability of data from South America, literature from Mexico and Central America is scarce. In Mexico, according to Zúñiga and Lozano, *P. h. capitis* is not reportable, and national data are non-existent.[20] A large study in Costa Rica conducted in 2003 studied 28 schools in San José, examining more than 7,000 children, of which 10% were infested.[21] For Honduras, only two publications could be found. One study, done among 40 children attending day care in the country's capital reports 30 (75%) infestations.[22] A second study undertaken in 2014 was a country-wide cross-sectional survey including 15,002 primary school students (96% from public schools). This study found that 1,484 children were infested, for a prevalence of 9.9%.[23] No other Honduran publications could be found despite an extensive search in PubMed and Google Scholar, as well as in the Health Virtual Library (http://bvsalud.org) and its regional databases, which include not only national/regional journals but also gray literature in several languages.

The present work responds to direct observations of widespread head lice infestations made by the authors while conducting research on helminth infections and providing free medical services in the study communities. A qualitative study was designed to obtain meaningful information that would inform future interventions in this community.

Methods

Ethical statement

The study was approved by the Research Ethics Board of both Brock University (file number 15-248) and the National Autonomous University of Honduras (file number 06-2016). In addition, approval was granted by the municipal public health director, community leaders, and school teachers. Informed consent was obtained from parents before children participated in the study, and verbal assent was also required by the child if older than 7 years of age.

Study design and research goal

This was a qualitative study conducted in June 2016 in a rural community, where pediculosis capitis had been observed to be a public health problem. This study aimed to understand the impact of *Pediculus humanus capitis* infestations in the lives of Honduran children living in extreme poverty.

Study area

This study was conducted in the Northern rural communities of La Hicaca and surrounding villages. La Hicaca is approximately 65 km from the city of Olanchito, Department of Yoro, Honduras. A medical brigade from Virginia Commonwealth University has been providing yearly free medical services to these communities since 2005, and for the past 5 years, they have partnered with a Honduran-Canadian research team working on NTDs. The research team was stationed in La Hicaca's rural health center, which also caters to inhabitants of 11 other nearby communities. All inhabitants were Spanish-speaking with strong ethnic heritage from the Pech ethnic group. Altogether, approximately 423 children reside in these communities.[24]

Participants, sampling, and data collection

Participants consisted of children aged 2–14 from La Hicaca and the surrounding communities. The study was advertised 2 weeks prior to the study by community leaders through the local catholic radio, by the health center's nurse, and through posters and flyers distributed ahead of the researchers' arrival. The sampling method used was voluntary response. To be enrolled in the study, children and one of their parents needed to give verbal assent and informed consent, respectively. For preschool children, only parental consent was required. However, they would not be enrolled in the study should they display resistance or discomfort during examination. Prior to inspection, a presentation was given to children, teachers, and parents in the primary school of La Hicaca explaining the study objectives and activities in which volunteers would participate. Once enrolled in the study, children were given an identification code to preserve the confidentiality of their information and samples.

A face-to-face semistructured questionnaire in Spanish was administered to participants (children and their parent/guardian) by two Honduran researchers knowledgeable of the local language and culture. Basic information about the child such as age, sex, and personal, and family history of head lice infestations was collected first. If children were 6 years of age or older, they were invited to answer some questions about transmission, symptoms linked with infestations, and treatment received at home. They were also asked about their own and other's feelings and attitudes towards infested children. At the end of the interview, children were asked to identify on a board the image of a head louse among pictures of a kissing bug, a bed bug, and a dog tick.

The accompanying adult responsible for the child was also interviewed to record their knowledge on transmission, current treatments and barriers to treatment. Some questions probed the community's and parent's reactions to a child with a head lice infestation.

Lice inspection

Children were inspected for *P. h. capitis* using a dry-combing technique with the aid of a V-Comb (Manufactured by ToLife Technologies, Australia. https://www.v-comb.ca/). The V-Comb is an electric, reusable stainless-steel comb that utilizes suction power to trap head lice and nits into single-use filters.

Researchers used personal protective equipment and wore an adjustable headset with magnifier lenses (MG81001-G 2 Led Headband Illuminating Magnifier 2) to better conduct the inspection.

When possible, two researchers dry-combed one child's head using the recommended V-comb, dry-combing technique. One researcher parted the hair into quadrants using hair clips and divided the quadrants into pieces of hair no longer than the width of the V-comb. The other researcher used the V-Comb to comb the pieces of hair from the nape of the neck to the top of the head 2–3 times using different angles. Stainless steel tweezers were also used to aid in picking up any live lice on the head or those that were trapped in the V-comb head. Breaks were taken during the inspection to avoid head/neck strain. Overall inspection of the whole head took an average of 20–30 minutes, depending on the length and thickness of hair.

During inspection, an assistant took notes on presence of lice and/or nits (eggs), hair length, color, texture, intensity of infection, and presence of a secondary infection. When only nits were found, care was taken to rule out dandruff, debris, or other insects, thus preventing false-positive reports. Although some authors are inclined to differentiate between active (live lice) or historic infestation (nits attached to the hair but >1 cm from the scalp),[25] this was not attempted in this study as in the tropics, viable eggs can be found further down on the hair.[26] Owing to the consent from research participants to undergo inspections lasting no longer than 30 minutes, it was not possible to recover all lice from children's scalp and hair to estimate infestation burden. Hence, a clinical approach was used to determine whether an infection was of high intensity or not. Because normally light infestations go unnoticed, and pruritus intensifies as sensitization and lice population grows, a high intensity infestation was defined as the presence of bites or scratching marks, commonly found in nonhairy regions such as the neck or behind the ears.[27] Children with secondary infections were referred to the healthcare center for treatment.

Between inspections, the head of the V-Comb, hair clips, and tweezers were sanitized in a 10% bleach solution and rinsed with clean water. V-comb filters were also changed between children and labelled with the child's identification code. For future work, lice and nits were transferred from the filters into vials containing 70% ethanol solution.

Children older than 2 years of age found infested were offered a nontoxic and pesticide-free head lice removal treatment (Resultz® Tribute Pharmaceuticals Canada Inc., London, Ontario, Canada), which contains 50% isopropyl myristate. Approval to use this product was obtained from a regional public health authority and the heath center nurse.

Parents or guardians were given a care package containing the treatment and graphic instructions with minimal text in Spanish. Verbal explanations were also provided to ensure proper usage. As per manufacturer instructions, the number of treatments provided depended on the hair length (30 ml for short, 60 ml for shoulder-length, and 90 ml for longer hair). Enough treatment was provided for two applications 7–10 days apart.

Data analysis

Data were entered into a database using Microsoft Excel 2016 (Microsoft Office 365 ProPlus), and descriptive statistics were calculated. Content analysis of participants' responses to the semistructured questionnaire was performed, and core information was consolidated into codes, which were then grouped into the following categories: (i) knowledge about transmission, (ii) infestation control, (iii) barriers to control, and (iv) impact on well-being. Code and categories were in turn interpreted to infer higher-level themes.

Peer-debriefing with a researcher not involved in the study was integrated early in the analysis to ensure interpretation of participants responses was unbiased and reasonable. Data analysis was an iterative process undertaken by two members of the research team (SJ and AS).

Results

Twenty-seven mothers accepted the invitation to participate in the study along with their children. Altogether, they enrolled 53 children.

Among 53 children enrolled, 52 were inspected for head lice with 1 child (age 5, male) withdrawing during the inspection process due to shyness. Participating children were aged 2–14 years (mean = 8 years old), and 42 (81%) were female. Inspected children belonged to 27 households residing in different villages, with 17 residing in La Hicaca and 35 in nearby communities. The average number of family members and children under 15 in the household was 4.7 and 2.3, respectively. Of the 52, 23 children attended primary school, while 25 were pre-school age. Four children were school-aged but did not attend school.

The overall proportion of *P. h. capitis* was 83% ($n = 43$). As Table 1 shows, girls had a higher proportion of infestations than boys.

Among girls, those with long hair were more likely to be infested than girls with shorter hair. Hair color and hair type did not seem to influence the likelihood of infestation (Table 2).

Children's responses

Only children aged 6 and older were administered the questionnaire. Even so, their capacity to respond was hindered by

Table 1 Proportion and intensity of *P. h. capitis* infestations through visual inspection and V-combing among 52 children

Infestation category	Number (%)
Total examined	52 (100)
Girls	42 (81)
Boys	10 (19)
Total not infested	9 (17)
Total infested (n = 43)	43 (83)
Girls	38 (88)
Boys	5 (12)
Both lice and nits	32 (74)
Lice only	3 (7)
Nits only	8 (19)
High intensity infestation	9 (21)
Secondary infections	2 (5)
Residence in La Hicaca core community	15
Residence in surrounding communities	28

shyness. Thus, the following results are based on a variable number of responses ranging from 6 to 25 children.

Knowledge about head lice transmission

Most children were aware of what human head lice were however struggled to identify them among a pictorial including three other arthropods (i.e., a kissing bug, a bed bug, and a tick).

Overall, a little over half of the children thought that *P. h. capitis* had the ability to live in bedding or walls, and almost half believed that domestic animals were also affected by the same lice and that it could transmitted to humans.

In terms of transmission, almost 50% of children believed that they could acquire head lice from other infested children. One female participant specified that they received head lice by "playing with other girls" (participant 21-A) or from siblings. More than a third of responding children believed that lice were also acquired when bathing in the river.

Table 2 Proportion of *P. h. capitis* stratified by hair characteristics in 52 examined children

	Examined ***N*** **= 52**	**Infested** ***N*** **= 43** ***n*** **(%)**
Hair color		
Black or dark brown	47	39 (83)
Medium or light brown	5	4 (80)
Hair length		
Long (past shoulders)	35	31 (88)
Medium (up to shoulders)	6	6 (100)
Short (at shoulders or shorter)	11	6 (55)
Hair type		
Straight	27	22 (82)
Wavy or curly	25	21 (84)

Infestation control

Most children (66.7%) said that they were not brought to the health center when they had lice, and only half of children received treatment from their parents.

As for methods of lice removal, children reported that it was common to use a fine-tooth comb but that manually removing them from the hair and scalp was far more common. They also knew of the existence of a shampoo treatment named Piojex® (permethrin); most did not recall receiving such treatment at home. Children who had a head lice infestation reported they actively participated in getting rid of their own head lice, with the majority manually picking them out by themselves or with help from a friend. Two children (participants 16-A, 21-A) further added that sometimes a "red powder" which they called "*veneno*" (poison) was used as treatment at home.

Barriers to control

Most children were aware the shampoo treatment was too expensive for their family to afford. One child (participant 05-0) expressed that sometimes they received treatment "when the gringos come every year" (referring to the medical brigade from Virginia Commonwealth University).

Impact on well-being

Children associated head lice with negative health effects such as itching (36%), lack of sleep (20%), and bumps/bites (16%). They knew that lice need to suck blood to live. They also recounted personal experience of being teased and feeling left out. When asked how the teacher responded to a child with head lice, over half of the children said the teacher did nothing, while a quarter indicated that their parents would be informed. One child stated: "When you have lice, the teacher says you're dirty and don't bathe" (participant 05-0).

Over half of children indicated that those with head lice were stigmatized in a school environment. In this regard, children made statements such as "other children tease them [a child with head lice], avoid them, don't sit beside them" (participant 01-A); "[they] laugh at them, call them names '*Piojosas*' [girl with lice], insult them, and tell them they should be embarrassed" because "...[children] don't want to be around a kid that has lice" (participant 15-0).

One child went on to say: "the life of a kid with lice... is a sad life" (participant 05-0).

Because this category entailed responses conceptualizing physical as well as mental health, it was further divided into the corresponding subcategories.

Mothers' responses

Infestation control

According to mothers, main methods of treatment used for *P. h. capitis* infestations was using Piojex® shampoo accompanied by combing with a fine-toothed comb as well as manually

picking out the head lice. However, many voiced that the shampoo was expensive and did not effectively remove all lice. Cutting the hair short was also reported as a manner of control. Some mothers reported applying a small amount of a red powder sold at the town's store (the "poison" mentioned by children). They explained that this powder was a plaguicide, but it could be used for head lice in small amounts. The powder was made into a paste with lard or cooking oil and was applied directly onto the scalp for "some time" followed by rinsing with water. A participant admitted "I'm not going to lie, we use the red powder because it works".

Researchers tried to purchase the powder to analyze it but were told that it was sold out. Further enquiry into the nature of the substance powder revealed that the poison was Marshal® 25 STW (DS) insecticide. The active ingredient is Carbosulfan, a reversible cholinesterase inhibitor, from the Carbamate Pesticide chemical family. Carbamate is listed by the United Nations Dangerous Goods Act as a class 6.1 substance, which can cause death or serious harm upon dermal contact, ingestion, or inhalation.[28] The local agriculture stores in the city nearby sell individual packets of Marshal DS insecticide in presentations of 50 g containing 12.5 g of active carbamate. The amount of insecticide and the proportion of active carbamate that caregivers and children are exposed to remain unknown.

One mother explained her choice of using this toxic paste as treatment, reflecting the gravity of the situation: "it's worse to have lice than any intestinal worm; you can actually feel them walking and moving around on your head" (participant 10-0).

Barriers to control

Barriers to successful treatment were attributed to socioeconomic and situational factors (poverty, long traveling distance to the health clinic). The "dirty river" was of special concerns since it was viewed as a reservoir for propagating transmission. Since there is no potable water in most communities, mothers recounted that the shallow and slow-flowing river serves as a common place for bathing and removal of head lice. They described that the child's hair is combed with a fine-tooth comb, which is rinsed in the river.

When asked what could be done to control the lice problem, mothers identified that universal treatment (all children with infestations needed to be treated) as well as water/river control and improved hygiene were necessary. However, because "people are too embarrassed to come forward and get help [and enroll in this research study]" (participant 12), treatment of all children was viewed as an implausible solution.

Impact on well-being

Mothers also expressed concepts interrelating the physical and mental health of their children.

Contrasting views were identified from mothers' response analysis. When questioned about how a mother feels when her own child or close relative are infested, the main codes reflected empathy and concern. Conversely, when speaking about others' children, these same participants suggested feelings of rejection and disgust.

Illustrating the former, mothers expressed that "[lice] suck their blood, take their energy away"; "[children] lack enthusiasm, [and] won't be able to go to school or study" (participant 03). "...They [the children] would be bothered and under stress" (participant 13). Mothers expressed worry that their children would be teased and bullied.

Religious, gendered, and cultural attitudes were captured in the following quotations: "The bible says that head lice are a plague" (participant 18); "Disgust is [a] normal [reaction] towards the girls but not for the boys" (participant 24).

Themes emerging from the data

Four major themes were developed from data critical analysis: health education, access to healthcare, socioeconomic factors, and child development and mental health. As Figure 1 shows, categories with their respective coded information cross themes' boundaries. For instance, community practices for infestation control and the barriers to access effective treatment are both related to access to healthcare (both personal and collective) as much as they are related to socioeconomic factors (in this community, individual differences play a paramount role in accessing treatment out-of-pocket).

Figure 1 also shows that themes were essential to developing recommendations for the community.

Discussion

Despite their ubiquity and impact on children, there is a paucity of research on head lice infestation across Central America. For Honduras, national or regional prevalence data are not nonexistent. Moreover, pediculosis has not been formally included in any of the public health national initiatives, nor in the "Strategic plan for the prevention, attention, control, and elimination of neglected infectious diseases in Honduras", formulated in 2012.[29] Unsurprisingly, epidemiological and clinical research on this topic is minimal in Honduras. As mentioned earlier, only two Honduras-based studies were identified in the published literature. Neither study included participants from rural areas nor did they conduct in-depth explorations of knowledge, attitudes, and overall impact of head lice infestations.

This study enrolled 52 children, and 43 (82.7%) were infested. This high proportion of pediculosis cannot be generalized to the community, since in our estimation, there was a significant self-selection bias. In enrolling research participants, two phenomena were observed: on one hand, some parents of infested children were interested in getting treatment of their children, while others (according to the health center nurse and other participants) were too ashamed to bring them for inspection. This self-selection likely resulted in an overestimation of the proportion of infested children. Despite this bias, our

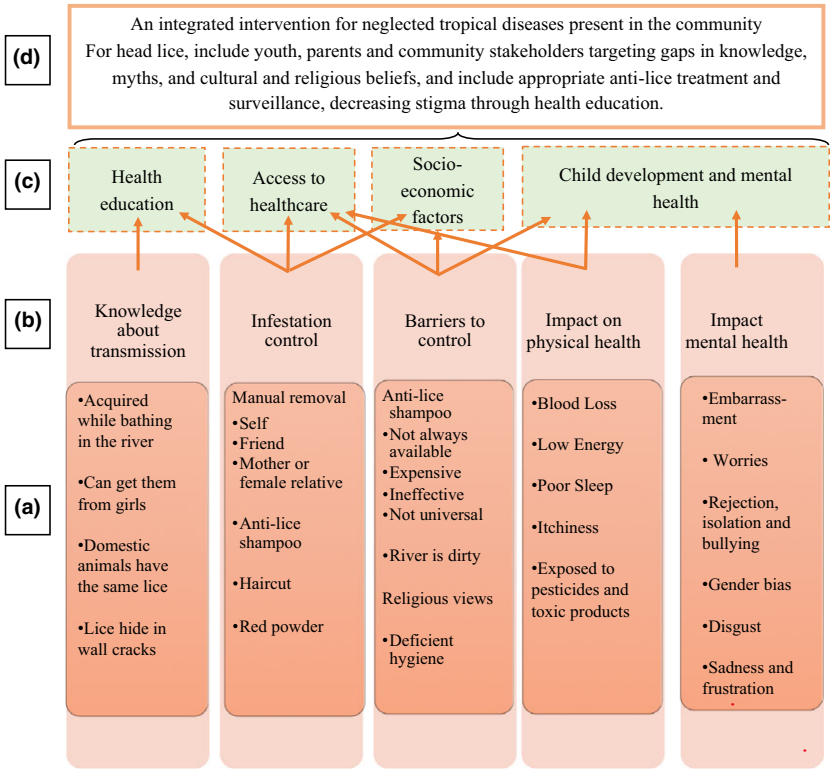

Figure 1 Analysis and interpretation of children and parent's combined responses. (a) descriptive codes, (b) categories, (c) themes, (d) study recommendations

findings are consistent with the literature. We found a higher proportion of head lice infestations in girls, indicating that gender-related attributes and behaviors such as longer hair, sharing of items, and increased physical contact all play an important role in transmission.[3,13,14,23,30]

Girls with long hair had the highest proportion of infestation. Similar findings have been reported from a study in Norway, in which hair length (especially medium length) was the only identified risk factor for infestation.[31]

Conversely, in this study, hair type and color did not seem to influence the likelihood of infestation, perhaps because these characteristics were very homogenous in the study population. An investigation in Brazil found that hair characteristics were associated with infestation rates among children.[32] This study proposed that children with shorter hair have a lower proportion of infestations due to potential early detection and easy maintenance, compared with children with long hair.[32]

Other findings from our study that coincided with the literature were: misconception about transmission among both children and their mothers,[33] stigmatization and bullying of infested children,[11,33-35] as well as structural barriers to obtain safe and/or effective treatment.[33,36]

The identification by participants of the river as a potential indirect vehicle of lice transmission was most intriguing. As lice removal in the study communities is frequently done by mothers while their children bathe in the river, participants believed that either free-floating head lice or stray hairs containing lice could lodge onto another child's hair. It is known that in water, lice enter a period of stasis and despite appearing to be dead to the human eye,[37] they do have the capability to survive for several hours in water, with reports ranging from 19 hours for body lice[38] to up to 36 hours for head lice.[20] Even though lice are equipped with morphological and physiological features allowing for this survival,[37,39,40] actual water transmission has been difficult to prove. A study by Canyon and Speare[37] investigated lice transmission in chlorinated swimming pools and found no head lice detached from a child's head in the water. In this study, whether the river serves as a transmission vehicle for pediculosis capitis remains to be investigated, but even if it were, its contribution would probably be minor, compared to head-to-head transmission.

The struggles of this population in accessing safe and effective treatment were another key finding of this study. Revealing the use of an agricultural pesticide for lice treatment was not easy for participants as they know it is not for human use. Resorting to all kinds of chemicals to treat head lice is common among endemic populations. In one of the Honduran studies, 13 of 30 mothers reported the use of household insecticides to treat infestation.[22] The international literature also contains accounts of the use of insecticides, gasoline or ethanol.[33,41,42] In Cuba, a wide

variety of toxic or flammable products have been linked to head lice control, including alcohol, vinegar, boric acid, malathion, lindane, temephos, DDT, and motor oil, among others.[43]

Our study is, to our knowledge, the first to document the use of carbosulfan. It is well established that carbosulfan is poisonous by inhalation and therefore poses a direct risk for village vendors, and both the caregiver preparing and applying the paste as well as the child receiving it.[28]

Observations from this and other studies indicate that a multiplicity of factors including lack of access to healthcare, unaffordable medications, shame or low motivation for seeking medical guidance, and desperation to rid children from a stigmatizing condition, contribute to the use of harmful substances.

Aggravating this situation is the increasing inefficacy of over-the-counter medications, especially the popular permethrin-based shampoo, as observed by some of our research participants. Lice resistance to this product is well established.[44]

Head lice infestations' negative effects on well-being have been documented extensively,[11,33-35] and the findings of this study are in full agreement. The sense of shame is particularly salient. The research team has been visiting the community for soil-transmitted helminth research and found more willingness in the community to provide stool samples and be tested for intestinal parasites than to participate in a head lice study that would provide treatment to those found infested. It seems that for this population, having lice is worse and more shameful because insects can be seen by others; they are felt moving around, they evoke disgust.

We have previously documented the nutritional deficiencies (mainly stunting) and pervasive intestinal parasitosis among the children living in these communities.[24] We have now revealed that head lice infestations are yet another difficult problem for this population.

Strengths and Limitations

Due to the high proportion of infested children enlisted in the study, we were able to obtain by direct account a deep insight into the problem as it is experienced by the community, particularly the extent of the impact head lice infestations have on children's well-being.

The study did not aim to achieve a sample representative of the general population, so cautious inferences should be made in terms of head lice prevalence among the population.

Conclusions and Recommendations

This is the first report investigating head lice infestation in rural Honduran communities. Novel findings include the widespread belief that lice can be acquired during bathing in the river, the use of toxic agricultural pesticide as a desperate measure of lice control, and the community's dependency on foreign researchers to bring to light and provide solutions to centuries-old health problems.

The study also confirmed the dire situation of the rural poor, their physical and mental health affected by pediculosis capitis as well as other NTDs. Altogether, these results highlight the need to reassess interventions towards combating NTDs with an integrated approach, within the framework of the Sustainable Development Goals. The recent addition of "Scabies and other ectoparasites" to WHO's NTD portfolio will likely raise awareness and encourage research and intervention to curtail this crippling and stigmatizing ectoparasitosis among neglected populations.

In light of the study findings, as summarized in Figure 1, a few recommendations can be offered.

First, the healthcare center needs to be supplied with effective antilice treatment in sufficient quantities for repeated rounds of treatment of individuals and/or families. The Honduran Ministry of Health should explore the possibility of integrating lice control to STH strategies. For example, topical ivermectin is already approved in the United States.[44] Trials using oral ivermectin have shown its superior efficacy over other products;[45] however, concerns about ivermectin resistance have already emerged.[46]

Second, a community-based active surveillance program must be implemented so new or recurrent cases are referred for treatment.

Finally, a comprehensive health education campaign across all population groups and community stakeholders needs to be deployed. Not only is health education an effective tool in reducing pediculosis prevalence,[11,42] it also contributes to the sustainability of control efforts.[47] Health education can also be a key element in demystifying this ectoparasitosis in the population. Very importantly, the dangers of utilizing toxic products needs to be known by all stakeholders including parents and the health center staff. In particular, recognizing and being prepared for carbosulfan's toxicity symptoms (bradycardia, muscle weakness, dizziness, diarrhea, CNS depression, and pulmonary edema[48]) may prove life-saving.

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