Human Ectoparasites Are Highly Prevalent in the Rural Communities of Northwest Ethiopia: A Community-Based Cross-Sectional Study

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ABSTRACT

BACKGROUND: Ectoparasites are organisms which inhabit the skin or outgrowths of the skin of another organism (the host). Many ectoparasites are known to be vectors of pathogens, which the parasites typically transmit to hosts. Though, ectoparasites are common in the vulnerable groups and economically disadvantaged communities, there is limited evidence on its magnitude in Ethiopia. This community-based cross-sectional study was, therefore, conducted to assess the prevalence and associated factors of ectoparasites in the rural communities of northwest Ethiopia.

METHODS: A community-based cross-sectional study design with structured observation was conducted among 1191 randomly selected rural households in northwest Ethiopia in May 2016. Data were collected using structured interviewer administered interview questionnaire and structured observation checklist. Prevalence of human ectoparasites in the rural communities was defined as the presence of one or more lice, fleas, bed bugs, mites, and ticks and the presence of these ectoparasites were observed by trained environmental health experts. Multivariable binary logistic regression analysis was used to identify variables associated with prevalence of ectoparasites on the basis of adjusted odds ratio (AOR) with 95% confidence interval (CI) and *P* values <.05.

RESULTS: Of a total of 1191 rural households, human or hair lice were observed in one or more of the family members in 186 (15.6%) rural households. Similarly, fleas were observed in more than half, 609 (51.1%) of rural households and bed bugs were observed in 441 (37%) rural households. Furthermore, mites and ticks were reported in 113 (9.5%) and 130 (10.9%) of the households respectively. Accordingly, one or more ectoparasites were observed in 865 of 1191 rural households. The presence of one or more ectoparasites was, therefore, found to be 72.6% (95% CI = 70%-75.1%). The prevalence of ectoparasites was statistically associated with educational status of the female head being not educated (AOR = 1.476, 95% CI = 1.001, 2.177) and absence close supervision by health extension workers (AOR = 2.151, 95% CI = 1.205, 3.843).

CONCLUSION: The prevalence of one or more ectoparasites was high in the rural communities of northwest Ethiopia. The high prevalence was associated with education status of the female head and close supervision of households by health extension workers. Disseminating health information about intervention strategies of ectoparasites and closely supervising the rural households need to be considered.

KEYWORDS: Ectoparasites, lice, fleas, bed bugs, mites and ticks, rural communities, northwest Ethiopia

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Background

The three major groups of parasites that can cause disease in humans are helminths, protozoans, and ectoparasites.[1] Ectoparasites are organisms that live in the skin or outgrowths of the skin of another organism (the host) for varying lengths of time and can be harmful to the latter.[2] Lice, fleas, bedbugs, mites, and ticks are examples of common human ectoparasites.[3,4]

Ectoparasitoses (infestations with parasites that live on or in the skin) are typically regarded as vexing disorders that receive little clinical attention. It is impossible to overestimate the importance of many ectoparasite species to humans.[3,4] However, depending on the socioeconomic setting, these infections can cause significant morbidity and affect a large portion of the population. Many ectoparasites are known vectors of pathogens, transmitting infections to hosts while feeding or, in some cases, defecating.[5-8]

Ectoparasitic infestation is common in developing countries,[9] and it is linked to poor weather conditions,[10-12] poor personal hygiene,[13-15] and poor socioeconomic conditions.[10,13,16] Although there is little evidence in Ethiopia, ectoparasites are common in economically disadvantaged communities. The purpose of this community-based cross-sectional study was to assess the prevalence and associated factors of ectoparasitosis in rural communities in northwest Ethiopia.

Study design and setting

A community-based cross sectional study design with structured observation was conducted in the former north Gondar administrative zone. Based on the 2007 census conducted by the central statistical agency of Ethiopia (CSA), the zone has a total population of 2 929 628, of whom 1 486 040 are men and 1 443 588 women. With an area of 45 944.63 km^2, the zone has a population density of 63.76. While 462 700 (15.79%) are urban inhabitants, another 2148 (0.07%) are pastoralists. A total of 654 803 households were counted in this zone, which results in an average of 4.47 persons to a household, and 631 509 housing units.[17]

Sample size determination and sampling procedures

The sample size was calculated using simple population proportion formula with the following assumptions: proportion of rural households who had one or more ectoparasites (p) = 50% since there was no similar study in the area, level of significance (α) = 5%, 95% confidence interval (standard normal probability), z: the standard normal tabulated value, and margin of error (d) = 5%.

$$n = \frac{(Z_{\alpha/2})^2 P(1-P)}{d^2} = \frac{(1.96)^2\, 0.5(1-0.5)}{0.05^2} = 384$$

The final sample size was 1210, with a design effect of 3 and a non-response rate of 5%. All households in the administrative zone of North Gondar were considered for sampling. First, we chose four districts at random using a simple random sampling technique, that is, the lottery method. Using the lottery method, we then selected four kebeles (the lowest administrative unit in Ethiopia) from each district. Finally, we selected 1210 rural households (which are the analysis unit of this study from each selected kebele, using a systematic random sampling technique). We began collecting data in households located on the right side of local administrators' offices. Assuming that the average number of households in each rural kebele is 200,[18,19] a sampling interval (K = 5) was calculated by dividing 200 by the kebele's predetermined sample size (n = 43). Following that, a number between one and the sampling interval was chosen at random using the lottery method, which is known as the random start, and was used as the first number included in the sample. Then, after the first random start, every fifth household was sampled until the desired sample size for each kebele was reached.

Measurement of outcome variable

Prevalence of human ectoparasites in the rural communities of northwest Ethiopia, the primary outcome variable of the study was defined as the presence of one or more insects such as lice, fleas, and bed bugs and arachnids such as mites and ticks. The prevalence of ectoparasites was calculated by dividing the number of households who had one or more ectoparasites with the total number of households included in the study. When one household had two or more family members with ectoparasites, we counted them as one household since our study or analysis units were households. Head louse and nits were thoroughly examined by close inspection and parting the hairs against their natural direction. We also inspect their hair by wet combing.[20] We asked the study participants to take of their undershirt and thoroughly inspected the presence of body louse and nits on the cloth. We investigated the presence of alive and dead bedbugs, nymphs and eggs in different areas such as bed sheet, bed frame, pillows, wooden furniture, frame of the door and window, cracks, and crevices using flash light.[21] We investigated the presence of scabies in one or more family members. Physical examination of the whole body was done for the presence of skin lesions typical for scabies for those household members who reported itching. Scabies was suspected, if an itchy papular, papular-crusted, or vesicular rash was present.[22]

Data collection tools and procedures

A structured interviewer administered interview questionnaire and structured observation checklist were used to collect data. The questionnaire was used to collect self-reported practices as well as socio-demographic data. For household-level information, we interviewed the female head. Using a checklist, we observed the personal hygiene condition of each family member in the selected household, as well as the sanitation condition of the living environment. Prior to data collection, the tools were tested. Data collectors were trained in the physical examination of ectoparasites as well as ethical issues during inspection. On a daily basis, field supervisors supervised the data collection process and checked the completeness of the data. The principal investigator and field supervisors met daily for a brief discussion of the problems or challenges that data collectors faced on each day of data collection in order to provide solutions.

Data processing and analysis

Data were entered using EPI-INFO version 3.5.3 statistical package and export into Statistical Package for Social Sciences (SPSS) version 20 for further analysis. For most variables, data were presented by frequencies and percentages. Univariable logistic regression analysis was used to choose variables for the multivariable logistic regression analysis, and variables which had P value less than .25 by the univariable analysis were then analyzed by multivariable analysis for controlling the possible effect of confounders. Finally, variables which had significant association were identified on the basis of AOR with 95% CI and P values $<.05$. Multicollinearity was tested using variance inflation factor (VIF) and model fitness was check using Hosmer and Lemeshow goodness-of-fit test.

Table 1. Sociodemographic characteristics of rural households included in this study, May 2016.

SOCIODEMOGRAPHIC CHARACTERISTICS	FREQUENCY	PERCENT
Occupants composition by sex (n=6097)		
Male	3189	52.3
Female	2908	47.7
Family size of households (n=1191)		
<5	677	56.8
>5	514	43.2
Maternal education (n=1086)		
No formal education	644	59.3
Attend formal education	442	40.7
Paternal education (n=1181)		
No formal education	889	75.3
Attend formal education	292	24.7
Have one or more domestic animals		
No	109	9.2
Yes	1082	90.8

Table 2. Access to health messages for the rural households in northwest Ethiopia, May 2016.

MEANS OF ACCESS FOR HEALTH INFORMATION	FREQUENCY	PERCENT
The family discussed about health issues		
Yes	812	68.2
No	379	31.8
Health professional closely supervised you		
Yes	967	81.2
No	224	18.8
Are you frequently supervised by the community leaders (n=1190)		
Yes	797	66.9
No	393	33.0
Have you discussed about health issues with the village health group?		
No health group in the village	287	24.1
Yes	524	44.0
No	379	31.8
Have you received health education in the last 3 months?		
Yes	565	47.4
No	626	52.6

Results

Sociodemographic characteristics of rural households

This study included 1191 rural households, with a response rate of 98.4%. The households that were included housed a total of 6097 people, with 3189 (52.3%) being male. A significant proportion of households, 514 (43.2%), had a family size of five or more. More than half of the female heads, 644 (59.3%), did not receive formal education. Similarly, three-fourths of the male heads, 889 (75.3%), did not attend formal education. The vast majority of households, 1087 (90.8%), had one or more domestic animals (Table 1).

Access to health messages

Eight hundred and twelve rural households (68.2%) reported that they discussed health issues with their family on a regular basis. Similarly, 524 (44%) of the households reported discussing health and sanitation issues with village health groups. The majority of households, 967 (81.2%) and 797 (66%), reported that health extension workers and local community leaders closely supervised them, respectively. In the 3 months preceding the survey, 565 (47.4%) of the households had received health education (Table 2).

Personal hygiene practices

A quarter, 307 (25.8%) of family members in the included households did not bathe once a week, according to this study. The vast majority of households, 1051 (88.2%), washed their clothes frequently. Four hundred and forty two (37.1%) of rural households reported that they frequently washed and changed their children's clothes. The majority of rural households, 993 (83.6%), reported regularly airing heavy cloths such as blankets and others (Table 3).

Housing condition

The roof of the vast majority of the residential buildings in the study area, 1085 (91.1%), was corrugated iron sheet, and the floor of almost all of the households, 1180 (99.1%), was earthen floor. Only 37 (3.1%) of the households had basic water access (20 l/c/d). Seven hundred and sixteen (60.1%) households had lived in a two-room or smaller house. Seven hundred and fifty (63%) of the households stated that they cleaned the physical structure of their home on a regular basis. The living compound was clean in 669 (56.2%) of the households. Five hundred and eighty (57.2%) of rural households reported rodents in their living quarters, and the vast majority, 1014 (85.1%), reported favorable conditions for vector breading (Table 4).

Prevalence of ectoparasites

Human or hair lice were found in one or more family members in 186 of 1191 rural households (15.6%). Similarly, fleas were found in more than half of rural households, 609 (51.1%), and

Table 3. Personal hygiene practices of the rural communities in northwest Ethiopia, May 2016.

PERSONAL HYGIENE PRACTICES	FREQUENCY	PERCENT
Family members wash their body with clean water and soap once a week		
No	307	25.8
Yes	884	74.2
Family members wash their hair at least once a week with clean water and soap (n = 1142)		
No	48	4.2
Yes	1094	95.8
Family members frequently wash their cloths		
No	140	11.8
Yes	1051	88.2
Wash and change child's/children's cloth regularly		
No child	605	50.8
Yes	442	37.1
No	144	12.1
Airing heavy cloths such as blankets and others regularly (n = 1188)		
Yes	993	83.6
No	195	16.4

Table 4. Housing conditions of the households in the rural settings of northwest Ethiopia, May 2016.

HOUSING CONDITION	FREQUENCY	PERCENT
Roofing		
Corrugated iron sheet	1085	91.1
Grass and others	106	8.9
Floor type		
Earth floor	1180	99.1
Concrete floor	11	0.9
Access to water		
No basic access	1154	96.9
Basic access	37	3.1
Number of rooms		
<2	716	60.1
>2	475	39.9
Cleaning practice of the physical structure		
Yes	750	63.0
No	441	37.0
Presence of rodents (n = 1014)		
Yes	580	57.2
No	434	42.8
Favorable conditions for vector breading		
Yes	1014	85.1
No	177	14.9
Condition of the living compound		
Clean	669	56.2
Not clean	522	43.8

bedbugs in 441 (37%). Furthermore, mites and ticks were found in 113 (9.5%) and 130 (10.9%) of the households, respectively. As a result, 865 of 1191 rural households had one or more ectoparasites, makes the prevalence of one or more ectoparasites 72.6% (95% CI = 70%-75.1%) (Figure 1). Only one ectoparasite was observed in 403 (46.6%) households, two ectoparasites were observed in 337 (39%), three different ectoparasites were observed in 100 (11.6%), four different ectoparasites were observed in 23 (2.7%), and five different ectoparasites were observed in 2 (0.2%) households.

Factor associated with prevalence of ectoparasites

Table 5 shows the factors associated with prevalence of one or more ectoparasites in the rural settings of northwest Ethiopia. Maternal education, health education, health supervision, access to water, number of rooms, cleaning practice of the physical structure of the house, and presence of rodents were entered to the final model. In the multivariable logistic regression analysis, maternal education and health supervision were significantly associated with prevalence of one or more ectoparasites in the rural communities of northwest Ethiopia. The prevalence of ectoparasites was 1.476 times more likely to be higher in households where the female head was not educated (AOR = 1.476, 95% CI = 1.001, 2.177). Similarly, the prevalence of ectoparasites was 2.151 times more likely to be higher in the rural households not closely supervised by health extension workers or other local health professionals compared with supervised households (AOR = 2.151, 95% CI = 1.205, 3.843).

Discussion

The prevalence of one or more ectoparasites in the rural communities of northwest Ethiopia was found to be 72.6% (95% CI = 70%-75.1%). The prevalence of ectoparasites reported by this study is lower than studies in Brazil (76%)[23] and in Britain(75%).[24] On the other hand, the finding of the current study is higher than findings of studies in Woreta town, Ethiopia (65.7%)[25] and in Iran (67.3%).[26] The higher prevalence could be attributed to poor hygiene practices in rural

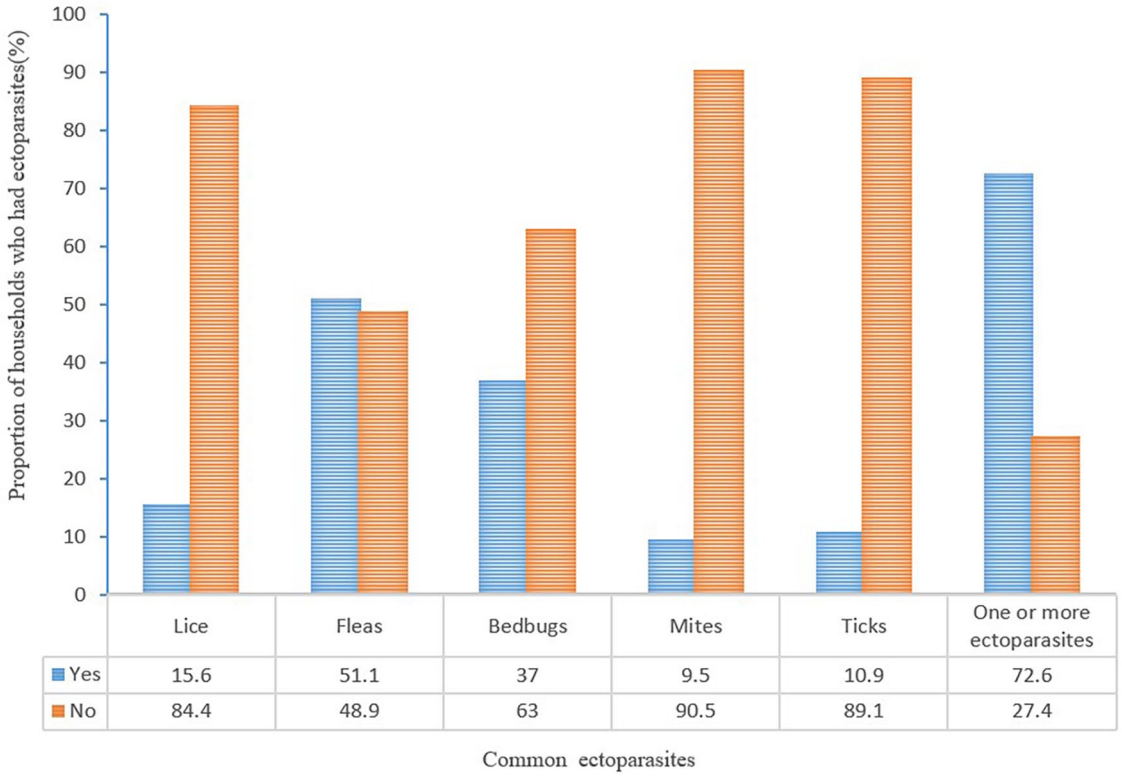

Figure 1. Prevalence of different ectoparasites in the rural communities of northwest Ethiopia, May 2016.

Table 5. Factors associated with prevalence of one or more ectoparasites in the rural communities of Ethiopia, May 2016.

VARIABLES	ECTOPARASITES		COR WITH 95% CI	AOR WITH 95% CI
	YES	NO		
Maternal education				
No formal education	654	235	1.2 (0.9, 1.6)	1.5 (1.0, 2.2)*
Attend formal education	203	89	1	
Health education				
Yes	413	152	1	
No	452	174	1.0 (0.7, 1.2)	0.9 (0.6, 1.3)
Health supervision				
Yes	691	276	1	
No	174	50	1.4 (1.0, 2.0)	2.2 (1.2, 3.8)**
Access to water				
No basic access	842	312	1.6 (0.8, 3.2)	1.9 (0.7, 4.8)
Basic access	23	14	1	
Number of rooms				
⩽2 rooms	525	191	1.1 (0.8, 1.4)	1.4 (0.9, 2.0)
>2 rooms	340	135	1	

(Continued)

Table 5. (Continued)

VARIABLES	ECTOPARASITES		COR WITH 95% CI	AOR WITH 95% CI
	YES	NO		
Cleaning practice of the physical structure				
Yes	531	219	1	
No	334	107	1.3 (1.0, 1.7)	1.3 (0.9, 2.0)
Presence of rodents				
Yes	501	79	1.2 (0.9, 1.7)	1.2 (0.9, 1.8)
No	364	70	1	

*P = 0.05. **P = 0.01, Hosmer and Lemeshow test = 0.078, and VIF = between 1.007 and 1.195.

communities as well as poor housing conditions. According to the current study, almost all (99.1%) of the living houses had earthen floors, and the living environment in 85.1% of the households was conducive to breading.

This study depicted that prevalence of ectoparasites in the rural households was statistically associated with the educational status of the female head. This is in agreement with findings of other studies.[25-27] This may be due to the fact that education is likely to enhance household health and sanitation practices. Education can increase awareness about the health effects of ectoparasites and prevention measures. It also encourages changes in behavior at the household level.[28,29]

The current study found that close supervision of households by health extension workers or other local health professionals was significantly associated with the prevalence of ectoparasites. This fact can be justified by stating that health supervision is the most effective way to disseminate health messages or health education to individual households and is effective in improving or maintaining household practices regarding housing sanitation and other health promotion measures. In area where the rural communities have no other sources of health information and low self-determination to improve hygiene and sanitation, close and regular supervision, and enforcement by health extension workers or other local health professionals is required.[30] The rural healthcare system need to initiate or strengthen leadership development programs to improve supervision capacity in rural areas.[29]

The high prevalence of ectoparasites has health implications. Transmission of vector-borne pathogens is strongly affected by abundance of vectors. Higher vector densities increase biting rates, which elevates the risk of pathogen transmission.[31] The probability of infection increases with the number of infectious bites.[32-34]

Conclusion

The prevalence of one or more ectoparasites was high in the rural communities of northwest Ethiopia. The high prevalence was associated with education status of the female head and close supervision of households by health extension workers. Disseminating health information about intervention strategies of ectoparasites and closely supervising the rural households need to be considered.

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Author Contributions

The study was designed by ZG. All the authors participated during data collection, data processing and coding, and analysis and interpretation of findings. ZG prepared the manuscript. All the authors read and approved the final manuscript.

Ethics Approval and Consent to Participate

Ethical clearance was obtained from the Institutional Review Board of the University of Gondar, and an official letter was submitted to the district administrators. There were no risks due to participation in this research project, and the collected data were used only for this research purpose. Verbal informed consent was obtained from the household heads. The information collected from each household kept with complete confidentiality.

Consent Publication

This manuscript does not contain any individual person's data.

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Availability of Data and Material

Data will be made available upon requesting the primary author.

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