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RESEARCH ARTICLE

KNOWLEDGE, ATTITUDES, AND PRACTICES OF METEHARA TOWN COMMUNITY TOWARDS BAT-BORNE DISEASES, CENTRAL ETHIOPIA: A CROSS-SECTIONAL STUDY

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ABSTRACT: This study assessed knowledge, attitudes, and practices of Metehara town community towards bat-borne diseases, where a novel coronavirus has recently been reported among cave bats in the area. A cross-sectional study was carried out between April 2021 and June 2021 among randomly selected individuals in the community. Data were collected using structured questionnaires. Multivariable logistic regression analysis was used to assess associations between socio-demographic characteristics and overall knowledge of respondents about bat-borne diseases. Out of 392 study participants, the majority (88.5%, n = 347) have heard that bats could transmit or serve as a source of disease to humans. Almost half of them (45.4%, n = 179) heard this information from the Metehara's community. About 40 (11.5%) of the participants perceived that bats could transmit rabies. Close to 26.3% (n=103) of the participants were found to have a high level of overall knowledge, 70.7% (n = 277) favorable overall attitudes, and 98.7% (n = 387) good overall practices towards bat-borne diseases. The overall knowledge about bat-borne diseases was strongly associated with observing wild animals in or around residents' houses. The majority of the participants had high overall attitudes and practices about bat-borne diseases, but their overall knowledge level was low. Hence, there is a need to create community awareness regarding the risk of bat-borne diseases along with bat conservation.

Key words/phrases: Attitude, Bat-borne diseases, Ethiopia, Knowledge, Metehara community, Practice.

INTRODUCTION

Bats constitute the second largest group and the most taxonomically diverse flying mammals (Sieradzki and Mikkola, 2022). They are important components of the ecosystem as they enhance cross pollination and seed

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dispersal during their search for food on different vegetation types. They also increase agricultural production by feeding on herbivorous arthropods and reducing insecticide use. They also fertilize soil through their faeces (guano) (Kunz *et al*., 2011).

In spite of their importance, bats serve as reservoirs of life-threatening viruses including zoonotic viruses, such as Rabies, Nipah, Marburg, and Ebola (Goldstein *et al*., 2018; Yob *et al*., 2001; Sah *et al*., 2022). Bats have been associated with viral disease outbreaks in humans and animals (Hayman, 2016). Severe acute respiratory syndrome coronavirus (SARS-CoV-1), Middle East respiratory syndrome coronavirus (MERS-CoV), Nipah virus, and most recently, coronavirus disease (SARS-CoV-2) emerged as important human diseases and are believed to spill over from bats (Hughes *et al*., 2009; Luby *et al*., 2009; Anthony *et al*., 2017; Ng and Tan, 2017; Zhou *et al*., 2020). In 1998, highly fatal outbreaks of the Nipah viral disease, originated from bats of the Pteropodidae family, were reported in South and Southeast Asian countries with a fatality rate of 40% to 75% (Chua *et al*., 2002; Singh *et al*., 2019). Research teams from Sierra Leone, Kenya discovered Bombali virus (Family Filoviridae; Genus Ebolavirus) among insectivorous bats (Goldstein *et al*., 2018; Forbes *et al*., 2019). Paramyxoviruses and a novel betacoronavirus were also identified among insectivorous bat species in Rwanda (Markotter *et al*., 2019). In Ethiopia, three coronaviruses and one payamyxovirus (*Coronavirus /Kenya/KY41/2006*, *Coronavirus /Kenya/KY22/2006*, *Eidolon bat coronavirus*, and (*PREDICT_PMV-24*), a new (novel) alphacoronavirus (*PREDICT_CoV-114*), and one novel paramyxovirus (*PREDICT_PMV-175*) were recently reported among insectivorous bats from cave and human dwellings in Metehara and Bati areas (Lane *et al*., 2022).

Human activities have resulted in widespread deforestation, urbanization, mining, and land use change, creating opportunities for overlapping human and bat habitation and increased risk of virus spillover events (Voigt and Kingston, 2016). In Ethiopia, there are at least 70 bat species among which the majority are insectivorous. Due to its geophysical location, the country is inhabited by diverse bat species. All the megabats in Africa belong to the Pteropodidae family of old world fruit bats and 11 of the species are documented in Ethiopia (NABU, 2017). The lesser mouse-tailed bat (*Rhinopoma hardwickii*) in caves and the little free-tailed bat (*Chaerephon pumilus*) on the roofs of human dwellings have recently been reported from Metehara area (Lane *et al*., 2022). The majority of the inhabitants are civil service employees and others are involved in trade and daily labour

activities. In Metehara, some people can easily come into contact with cave bats when using caves as shelter or a water source on the cave floor for washing trucks (personal observation). Moreover, excreta of the bats that live on roofs of dwellings may contaminate food and expose humans to viral infection.

In this context, assessment of knowledge, attitudes and practices of the community in Metehara town towards the potential risk of bat-borne infections remains crucial. To the best of our knowledge, there was no prior data on the knowledge, attitude and practices of the community about bat-borne diseases. Therefore, this study aimed to assess knowledge, attitudes, and practices of the community in Metehara town towards bat-borne diseases, in connection with the recently reported novel coronaviruses among cave bats (Lane *et al*., 2022).

MATERIALS AND METHODS

Study area and population

The study was conducted in Metehara town, Fentale woreda, Oromia regional state, central Ethiopia (Fig. 1). The town is about 190 km from Addis Ababa and situated in the upper Awash Valley. It is located at 08° 53′ 153″N, 39° 55′ 1.32″E, and has an elevation of about 947 meters above sea level. Metehara is adjacent to Awash Park and the Afar Regional State along the Addis Ababa-Djibouti highway. It is the major transit corridor connecting central Ethiopia and Djibouti. The town comprised three kebeles (the smallest administrative unit in Ethiopia); Metehara 01, Addis Ketema 01, and Merti. Inhabitants of the three kebeles were eligible to be included in the study.

Study design and sample size determination

A cross-sectional study was carried out between April 2021 and June 2021 to assess knowledge, attitudes and practices towards bat-borne diseases among residents in Metehara town. To our knowledge, no similar study was conducted in the area previously. Hence, we assumed that 50% of the population knew about the bat-borne disease. Accordingly, the sample size was calculated assuming 50% proportion, 95% confidence interval, 5% precision and the sample size was 385. Considering a 5% non-response rate, the total sample size was increased to 404 (Daniel, 1995; Phuyal *et al*., 2022).

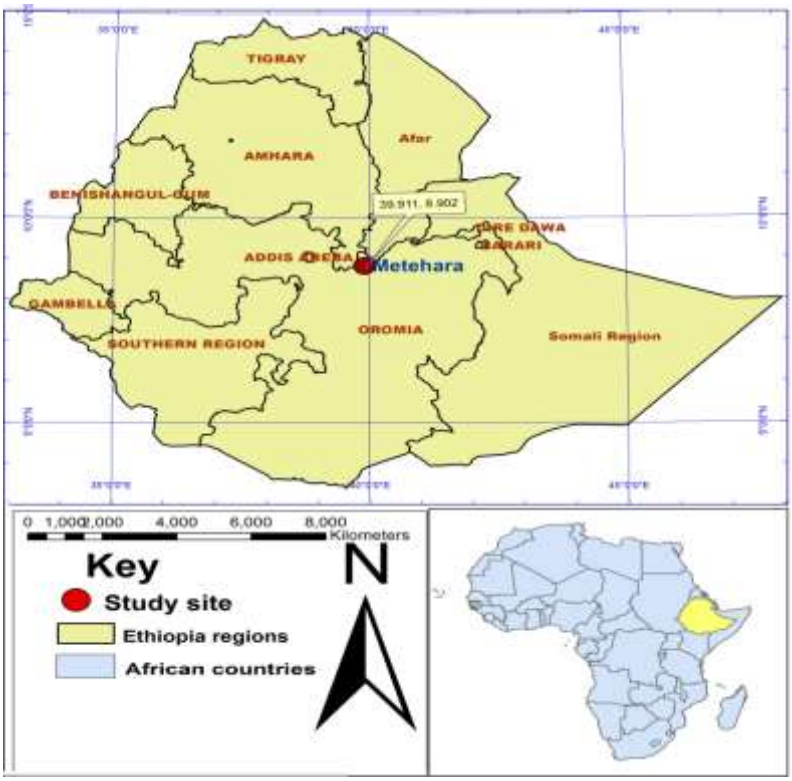

Fig. 1. Geographical location of Metehara town, Fentale woreda, Oromia regional state, central Ethiopia. Map generated using ArcGIS 10.1 software.

Eligibility criteria and data collection

The estimated total sample size was proportionally distributed among the three kebeles in the town. Then the sample size calculated for each kebele was divided by the total household to determine the interval between the houses for sampling the study participants. One household was selected by a lottery system and then every n^{th} house was interviewed by walking from house to house. Individuals of ages 18 years or above, males or females who lived in the area for at least one year, were healthy, and voluntary were interviewed in the study. A structured questionnaire with 36 items in four sections was used to collect information on community members' socio-demographic characteristics, knowledge, attitudes, and practices of the about bat-borne diseases.

The overall knowledge of the participants a bat-borne diseases was assessed using nine main questions (Table 2). The responses to these nine questions

were added to generate the overall knowledge score ranging from 0 to 9. A "correct/yes response" was given a score of one, while "incorrect/no and Don't know" responses were scored as zero. Then, the response was categorized as high for scores ≥ 6 (60% cut-off point) and as low for scores ≤ 5 (50%) overall knowledge of bat-borne disease. The attitude of the participants was assessed using eight questions (Table 3). The responses to these questions were combined to generate an overall attitude score ranging from 0 to 8. Score one was given for "correct / yes response" and zero for "incorrect/no response". The responses were then categorized as good attitude for scores ≥ 5 and unfavourable attitude for scores ≤ 4. Similarly, the practices of study participant towards bat-borne diseases were assessed using seven questions (Table 4). The overall practice score of the study participant about bat-borne diseases ranged from 0 to 7. The scores of ≥ 4 were regarded as good practice, and those who scored ≤ 3 were considered to have low prevention practices for bat-borne diseases (Shabani *et al*., 2015).

The questionnaire was first developed in English and later translated into the local language (Afaan Oromo). Prior to the data collection, the questionnaire was pilot tested for clarity and consistency on 30 respondents. Metehara town health office members carried out the data collection while the investigators supervised the collection.

Data analysis

The data was entered, cleaned, coded, and analyzed using statistical package for social sciences (SPSS, version 20). Descriptive statistics was used to calculate frequencies, mean and percentages. Multiple logistic regressions analysis was used to measure associations of socio-demographic characteristics of the participants with their overall knowledge of bat-borne diseases. P-values below 0.05 were considered as indicators of statistical significance.

Ethical consideration

The study obtained ethical clearance (Ref. No.:ALPB/IRB/004/2015/16) from Institutional Review Board (IRB) of the Aklilu Lemma Institute of Pathobiology (ALIPB), Addis Ababa University. Permission to conduct the study was obtained from the city administration and local public health office of Metehara town. The aim of the study was adequately explained to the participants by the research team and verbal consent was obtained from each participant prior to the interview. Only volunteered participants were

interviewed face-to-face and information was kept confidential.

RESULTS

Socio-demographic characteristics of the study participants

A total of 392 respondents participated in the study in Metehara town with a response rate of 97.0%. More than half of the participants were females (n = 225; 57.4%) (Table 1). The largest age group was 18–29 (n = 176; 44.9%) and the mean age was 35.29 years. About (n = 235; 60%) of the study participants completed primary or secondary school education while (n = 70; 17.9%) were not able to read and write. Over half (n = 206; 52.6%) of the participants were housewives, (n = 98; 25.0%) merchants, (n = 36; 9.2%) government employees, and (n = 35; 8.9%) students.

Table 1. Socio-demographic characteristics of the study participants in Metehara town, Oromia regional state, central Ethiopia, 2021.

Variable	Category	No (%)
Sex	Male	16 (42.6)
	Female	225 (57.4)
Age	18–29	176 (44.9)
Mean 35.29	30–44	114 (29.1)
Median 30	45–59	67 (17.1)
(Min-Max) (18–97)	60 and over	35 (8.9)
Education	Illiterate	70 (17.9)
	Read and write	18 (4.6)
	Primary school	118 (30.1)
	Secondary school	117 (29.8)
	College/University	69 (17.6)
Occupation	Farmer	5 (1.3)
	Merchant	98 (25.0)
	Government employee	36 (9.2)
	Student	35 (8.9)
	Housewife/unemployed	206 (52.6)
	Daily labourer	12 (3.1)
Length of living (year)	less than 25	246 (62.8)
Mean 21.60	25–50	139 (35.5)
Median 20 (Min-Max) (1–65)	over 50	7 (1.8)
Having domestic animal	Yes	181 (46.2)
	No	211 (53.8)
Observing wild animals in /around house	Yes	182 (46.4)
	No	210 (53.6)
Ever seen bats in /around house	Yes	305 (77.8)
	No	87 (22.2)

Knowledge of the study participants towards bat-borne diseases

Table 2 shows the general knowledge of the study participants about zoonoses and bat-borne diseases in Metehara town. More than half of the respondents (n = 253; 64.5%) reported that animals could transmit disease

to humans. Similar proportion (n = 269; 68.6%) reported that eating animal products that are not well-cooked could cause diseases. Only 46 (11.7%) responded that people get diseases not just through direct contact with animals. Out of the total 392 participants, the majority (n = 347; 88.5%) heard that bats could transmit diseases and nearly half of them (n = 158; 45.4%) heard the information mainly from the local community, and some (n = 69; 19.9%) from their families but few (n = 6; 1.8.%) heard the information from television and radio (Fig. 2). Out of the 347 respondents who heard about bat-borne diseases, the majority 301 (86.7%) reportedly mentioned bats transmit diseases through their urine or faeces followed by those (n = 111; 32%) who believed they transmit through their bites or scratches. Additionally, 147 (42.4%) respondents assumed eating raw or not well-cooked bats as the cause for the transmission of diseases; about 40 (11.5%) also perceived that bats could transmit rabies.

Table 2. Knowledge of the study participants about zoonotic and bat-borne diseases in Metehara town, Oromia regional state, central Ethiopia, 2021.

	Variables	**Category**	**No. (%)**
Knowledge of zoonotic disease	Do animals transmit disease to human?	Yes	253 (64.5)
		No	15 (3.8)
		DK	124 (31.6)
	Name of animals which transmit disease to human	Dog	87 (22.2)
		Bat	80 (20.4)
		Cattle	30 (7.7)
		Others	56 (14.4)
		DK	139 (35.5)
	Name of diseases transmitted from animal to human	Rabies	86 (21.9)
		Hepatitis	73 (18.6)
		Corona	4 (1.0)
		Others	13 (3.5)
		DK	216 (55.1)
	Do people get disease only when they have direct contact with animal? *	Yes	199 (50.8)
		No	46 (11.7)
		DK	147 (37.5)
	Does eating under cooked animals product cause disease to human?	Yes	269 (68.6)
		No	12 (3.1)
		DK	111 (28.3)
Knowledge of bat-borne disease	Have you ever heard about diseases transmitted from bats?	Yes	347 (88.5)
		No	45 (11.5)
	Source of information about bat-borne diseases	Yes	347 (88.5)
		DK	45 (11.5)
	Do bats transmit disease to human?	Yes	326 (93.9)
		No	5 (1.4)
		DK	16 (4.6)
	Do bats transmit disease to	Yes	76 (21.9)

Variables	Category	No. (%)
other animals?	No	43 (12.4)
	DK	228 (65.7)
Do people get disease due to exposure to bat bite or scratch?	Yes	111 (32.0)
	No	99 (28.5)
	DK	137 (39.5)
Does eating raw or under cooked bats cause diseases?	Yes	147 (42.4)
	No	60 (17.3)
	DK	140 (40.3)
Do bats transmit diseases their bat urine or faeces?	Yes	301 (86.7)
	No	7 (2.0)
	DK	39 (11.2)
Do bats transmit rabies?	Yes	40 (11.5)
	No	50 (14.4)
	DK	257 (74.1)

* Negative statement.; DK- Don't know

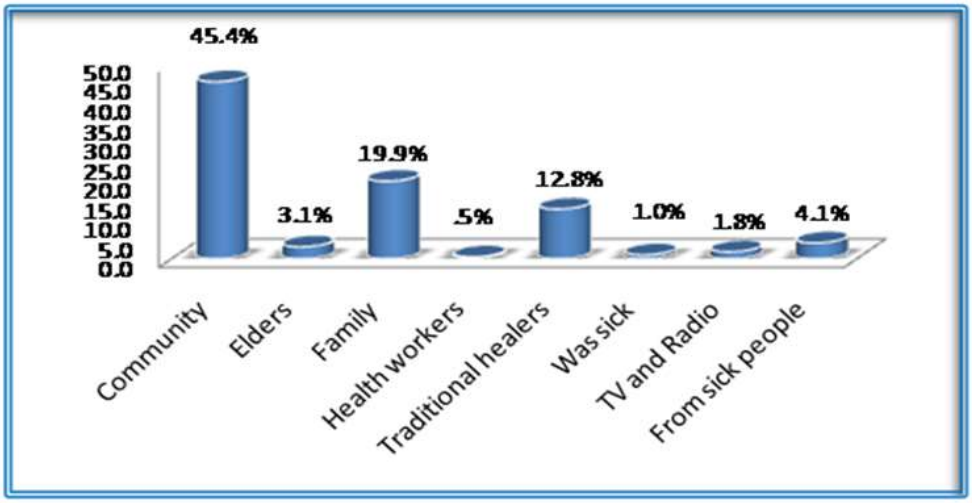

Fig. 2. Information source of Metehara town community members about bat-borne diseases, Oromia regional state, Ethiopia, 2021.

Attitudes of the study participants towards bat-borne diseases

Table 3 presents the responses related to the attitudes of the study participants towards bat-borne diseases in Metehara town. The majority of the respondents (n = 278; 70.9%) believed that contacting with bats causes diseases. More than half (n = 254; 64.8%) of participants responded that getting into bat caves or going near bat roost increased the risk of getting disease from bats. Over (n = 311; 79%) of the participants perceived that diseases from bats could be serious or life-threatening, and over (n = 335;

85%) perceived that bat faeces or urine can make people sick. On the other hand, about (n = 164; 41.8%) of the respondents believed that bats should be protected.

Table 3. Attitude of the study participants about bat-borne diseases in Metehara town, Oromia regional state, central Ethiopia, 2021.

Variables	Category	No. (%)
Do you think people contacting bats get diseases?	Yes	278 (70.9)
	No	114 (29.1)
Do you think the food and fruit that bats ate partly are contaminated?	Yes	253 (64.5)
	No	139 (35.5)
Do you think getting into bat caves or bat habitats increase the risk of getting a disease?	Yes	254 (64.8)
	No	138 (35.2)
Do you think diseases from bats can be serious or life-threatening?	Yes	311 (79.3)
	No	81 (20.7)
Do you believe that touching bats with bare hands is not risky?*	Yes	209 (53.3)
	No	183 (46.7)
Do you think excretions of bats such as feces or urine can make you sick?	Yes	335 (85.5)
	No	57 (14.5)
Do you think bats should be protected?	Yes	164 (41.8)
	No	288 (58.2)
Do you think eating bats are good for health?	Yes	103 (26.3)
	No	289 (73.7)

* Negative statement

Practices of the study participants towards bat-borne diseases

Of the 392 study participants, only 93 (23.7%) have reportedly experienced touching a bat, its carcass or faeces (Table 4). About 42 (10.7%) of them touched bats using protective means such as gloves. Some individuals (n = 83; 21.2%) have reportedly hunted bats but only five (1.3%) of them butchered or prepared bats. Ten persons (n = 10; 2.6%) have reportedly eaten bats. Very few respondents (n = 2; 0.5%) reportedly collected bat faeces (guano) and only 1 (0.3%) was bitten or scratched by bats.

Table 4. Practices of study participants about bat-borne diseases, Metehara town, Oromia regional state, central Ethiopia, 2021.

Variables	Category	No. (%)
Have you ever touched a bat, its carcass or bat faeces?	Yes	93 (23.7)
	No	299 (76.3)
Using any protective measure such as gloves when touching a bat, its carcass or bat faeces?	Yes	42 (10.7)
	No	350 (89.3)
Have you ever hunted bats?	Yes	83 (21.2)
	No	309 (78.8)
Have you ever butchered/ prepared bats?	Yes	5 (1.3)
	No	378 (98.7)
Have you ever eaten bats?	Yes	10 (2.6)
	No	382 (97.4)
Have you ever collected bat faeces (guano)?	Yes	2 (0.5)
	No	390 (99.5)
Have you ever been bitten or scratched by bats?	Yes	1 (0.3)
	No	391 (99.7)

Overall knowledge, attitude, and practices of the study participants towards bat-borne diseases

Among the 392 community members who participated in the study 103 (26.3%) had a high level of overall knowledge, 277 (70.7%) had good overall attitudes, and almost all (n = 387; 98.7%) had good practices towards bat-borne diseases (Fig. 3). The multivariable logistic regression analysis showed a statistically significant association between having high overall knowledge and observing wild animals in or around residents' house (AOR = 4.11; 95% CI: 2.42, 6.98, P<0.001). No other socio-demographic characteristics were observed to be significantly associated with high overall knowledge (Table 5).

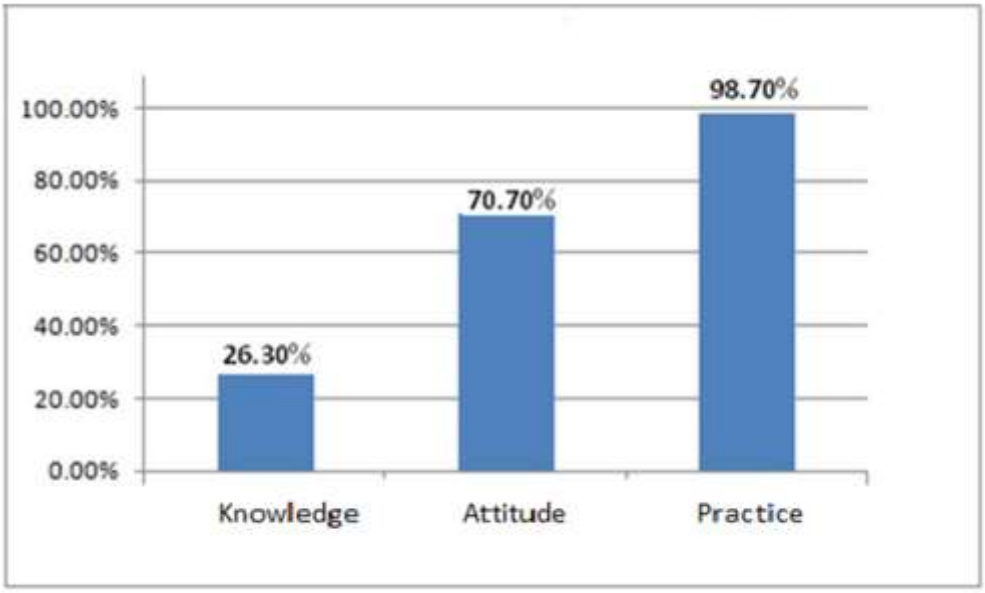

Fig. 3. Overall knowledge, attitudes, and practices score of the study participants about bat-borne diseases in Metehara town, Oromia regional state, central Ethiopia, 2021.

Table 5. Association of socio-demographic characteristics of the study participants with their overall knowledge of bat-borne diseases, Metehara town, Oromia regional state, central Ethiopia, 2021.

Description		**Overall knowledge High no (%)**	**Low no (%)**	**AOR (95% CI)**	**P value**
Sex	Male	49 (12.5)	118 (30.1)	1.19 (0.69, 2.05)	0.52
	Female	54 (13.8)	171 (43.6)	1.00	
Age	18–29	53 (13.5)	123 (31.4)	3.15 (0.90, 10.97)	0.07
	30–44	28 (7.1)	86 (21.9)	1.99 (0.58, 6.87)	0.27
	45–59	17 (4.3)	50 (12.8)	1.90 (0.57, 6.39)	0.30
	60 and over	5 (1.3)	30 (7.7)	1.00	
Education	No education	17 (4.3)	53 (13.5)	1.42 (0.56, 3.61)	0.46
	Read and write	5 (1.3)	13 (3.3)	1.18 (0.33, 4.25)	0.80
	Primary school	23 (5.9)	95 (24.2)	0.68 (0.32, 1.47)	0.33
	Secondary school	35 (8.9)	82 (20.9)	1.20 (0.57, 2.52)	0.62
	College/University	23 (5.9)	46 (11.7)	1.00	
Occupation	Farmer	3 (0.8)	2 (0.5)	1.56 (0.16, 15.06)	0.70
	Merchant	24 (6.1)	74 (18.9)	0.79 (0.19, 3.25)	0.74
	Government employee	13 (3.3)	23 (5.6)	1.22 (0.26, 5.72)	0.80
	Student	12 (3.1)	23 (5.9)	0.65 (0.13, 3.16)	0.59
	Housewife/ unemployed	47 (12.0)	159 (40.6)	0.79 (0.20, 3.11)	0.73
	Daily labourer	4 (1.0)	8 (2.0)	1.00	

Description		Overall knowledge High no (%)	Low no (%)	AOR (95% CI)	P value
Length of living (year)	Less than 25	69 (17.6)	177 (45.2)	1.12 (0.11, 11.35)	0.93
	25–50	33 (8.4)	106 (27.0)	1.02 (0.10, 10.18)	0.99
	Over 50	1 (0.3)	6 (1.5)	1.00	
Having domestic animal	Yes	48 (12.2)	133 (33.9)	0.85 (0.52, 1.39)	0.52
	No	55 (14.0)	156 (39.8)	1.00	
Observing wild animals in /around house	Yes	72 (18.4)	110 (28.1)	4.11 (2.42, 6.98)	<0.001*
	No	31 (7.9)	179 (45.7)	1.00	
Ever seen bats in /around house	Yes	79 (20.2)	226 (57.7)	0.916 (0.501–1.677)	0.777
	No	24 (6.1)	63 (16.1)	1.00	

*Significant at p<0.05. Hosmer–Lemshow goodness of fit is 0.880. CI (Confidence Interval) and AOR (Adjusted odds ratio)

DISCUSSION

This study was conducted to assess knowledge, attitudes, and practices of the community towards bat-borne diseases in Metehara town, central Ethiopia. In the study, a large proportion (64.5%) of the study participants perceived that animals transmit or serve as the source of diseases to humans. Furthermore, a similar proportion (68.6%) also mentioned that eating undercooked animal products can expose people to disease. However, these perceptions are lower than to the previous reports from Asella town (80.6%) by Gizachew Abera *et al*. (2016) and Bishoftu town (96.2%) by Dagne Tsegaye *et al*. (2022) in Ethiopia. These knowledge differences could result from variations in education status, source and frequency of information, and living style. This observation underlines the need to strengthen community awareness regarding disease transmission in general terms from animals to humans to prevent the transmission of several zoonotic diseases.

Although the study participants scored low overall knowledge of bat-borne diseases in the study area, surprisingly a very large proportion (88.5%) of them mentioned that bats could transmit diseases to humans through their urine or faeces. In this regard, the perception of this community is much higher than the community in central Thailand (25%) where a similar study was conducted by Agari *et al*. (2018). The discrepancy between the two communities can be explained by the difference in the respective populations and study periods and ecological conditions. Furthermore, this can also be an indication that the study participants are aware of the role of bats in transmitting diseases to humans and also their importance as disease reservoirs. On the hand, only a few study participants in Metehara town mentioned that bats could transmit rabies. This community perception is

comparable to the report from a rural community in Guatemala (10%), but much lower than the reports from Malaysia (37%) (Moran *et al*., 2015; Mohamed *et al*., 2019). This could result from variation in the prevalence of the diseases and the strong association of dogs with rabies in the society.

In the present study, the only predictor that was significantly associated with the high knowledge level towards bat-borne diseases was a history of observing a wild animal in or around human dwellings. About half of the study participants had knowledge of bat-borne diseases heard from the local community, but few heard the information from the media.

The majority (70.9%) of the study participants believed that people get disease when contacting bats. This observation is relatively lower compared to other studies in Malaysia (Nurul *et al*., 2018; Mohamed *et al*., 2019). They further perceived that food or fruits partially fed by bats, going to bat caves, and touching bat excreta are some of the ways through which diseases are transmitted. This attitude of the community members plays an essential part in the adoption of prevention and control measures for the diseases that are transmissible from bats to human.

In the present study, only a small proportion (23.7%) of the study participants mentioned that they touched a bat, its carcass, or bat faeces, and few who ever touched bats or bat carcasses used protective materials. This practice is similar to the results reported in Malaysia (Mohamed *et al*., 2019). Such practices have further shown that communities in the study area perceive bats as a source of life-threatening diseases in humans. On the other hand, about 41.8% of the community members who participated in the study believed that bats should be protected. This could arise from the fact that bats meat or their carcass mixed with herbal medicine are being used for the treatment of liver diseases in the traditional healthcare system of Ethiopia (Hodes and Belete Teferedegne, 1996). However, the negative perception of the community on bats and the practice of hunting bats could affect survival of the bats in the area. Thus, there is a need to create programmatic community awareness about bat-borne diseases and behavioural change strategies for living safely with bats, such as using non-lethal controlling methods since the bats are very useful and contribute to a healthy ecosystem.

CONCLUSION

The study participants in Metehara town generally have better knowledge of zoonotic diseases, specifically bat-borne diseases. However, their overall knowledge of diseases transmitted by bats is limited, except for the few who

perceive that bats transmit rabies. Therefore, there is a need to design relevant community health education to create awareness about bat-borne diseases, including bat conservation, through health extension workers, community leaders, and public mass media. Detailed epidemiological studies on the extent of major zoonotic and bat-borne diseases in the area also need to be undertaken.

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