



## Knowledge, Perception and Practice Related to Bovine Tuberculosis and Health Service-Seeking Behavior of Urban and Peri-Urban Dairy Producers in Ethiopia

Tilaye Teklewold<sup>a</sup>, Muluaem Ambaw<sup>b</sup>, Likawent Yeheyis<sup>a\*</sup> , Adam Bekele<sup>b</sup>,  
Henrietta L Moore<sup>c</sup>, Stefan Berg<sup>d</sup>, and Ayalew Assefa<sup>e</sup>

<sup>a</sup>Amhara Region Agricultural Research Institute (ARARI), P.O. Box 527, Bahir Dar, Ethiopia

<sup>b</sup>Ethiopian Institute of Agricultural Research (EIAR), Addis Ababa, Ethiopia

<sup>c</sup>Institute for Global Prosperity, University College London, United Kingdom

<sup>d</sup>Animal and Plant Health Agency, United Kingdom

<sup>e</sup>International Livestock Research Institute, Addis Ababa, Ethiopia

### ABSTRACT

Bovine tuberculosis (TB) creates a substantial public health burden and economic loss in low- and middle-income countries, including Ethiopia. Close interaction between animals and humans is a primary contributor to the transmission of the disease. This study was conducted to identify existing knowledge and practice around zoonotic tuberculosis and related health service-seeking behavior among dairy farmers in Ethiopia's urban and peri-urban dairy belt areas. A cross-sectional household survey with random sampling was conducted among 480 dairy farmers. We found that 80% of respondents seek modern health services when faced with major illnesses. When they were asked to evaluate their own household's health status, 36% indicated that their health status was excellent, and only 5% said that their health status was poor. Educational status, region, household size, household residence, and income were significantly associated ( $p < 0.05$ ) with the health-seeking behavior of participants. General awareness of tuberculosis was found to be high, with over 92% of participants having knowledge about the disease. However, there was room for improvement in their understanding of reverse zoonosis and certain practices aimed at TB prevention. Factors such as household size, education level, and health status of the participants ( $p < 0.05$ ) were found to be associated with TB knowledge. Given the significant impact of the disease, it is highly recommended to plan a cost-effective intervention strategy. This could potentially include training and awareness programs that focus on the transmission routes of bovine tuberculosis, sources of infection, and methods of control and prevention.

**Keywords:** Bovine tuberculosis, dairy farms, health-seeking, knowledge, urban and peri-urban, prevention.

### INTRODUCTION

In developing countries, animals and humans share the same microenvironment and interact closely. These interactions are increasing due to the shift in these countries from an extensive rural livestock production system to the intensified combined urban and peri-urban livestock farming that has developed to satisfy the increasing demand for animal products. This trend largely contributes to the ongoing transmission of shared infectious zoonotic diseases from cattle to humans, such as

tuberculosis, brucellosis, anthrax, and rabies (Bonfrer et al., 2014). Bovine tuberculosis, caused by the bacterium *Mycobacterium bovis*, is one of the main zoonotic diseases affecting animals and humans (Cosivi et al., 1998; Thoen et al., 2006). It is part of the *Mycobacterium tuberculosis* complex and can be transmitted through contact with infected animal waste or by consuming raw dairy or meat products. People who work with animals or their products, such as dairy farmers, abattoir workers, butchers, and processors, are particularly at risk of contracting bovine tuberculosis due to

\*Corresponding author: [likawenty@yahoo.com](mailto:likawenty@yahoo.com)

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frequent exposure to these sources. This disease is a growing concern as it has the potential to spread among different species (Constable et al., 2017).

Ethiopia, a densely populated country with over 100 million people and a huge cattle population that stands number one in Africa, has a high prevalence of bovine tuberculosis (bTB). Bovine TB in cattle is manifested throughout different agroecological zones of Ethiopia. Its prevalence in cattle ranges from 16% to 66% in different farming systems. The pooled prevalence from a meta-analysis study indicated that the proportion of bovine tuberculosis is around 6%. Cattle kept under intensive and semi-intensive production systems had a higher prevalence of bTB, reaching 17%. Population growth, rapid urbanization, and change in food habits, in which more people consume more animal-source foods, led to an intensification of dairy and feedlot farms in urban and peri-urban areas. The situation created an environment conducive to spreading zoonotic bovine tuberculosis. Besides the limitation of few advanced diagnostic centers, a lack of understanding about the disease and the habit of consumption of raw meat and milk among Ethiopians contributed to the country's higher burden of the disease (Alemayehu et al., 2008; Ameni & Erkihun, 2007; Sibhat et al., 2017). The disease is highly prevalent in crossbred dairy cows in urban and peri-urban areas of Ethiopia (Ameni et al., 2013; Firdessa et al., 2012; Tora et al., 2022). Dairy farmers in urban and peri-urban areas are occupationally at risk of being infected with zoonotic tuberculosis-infected meat (Fikre et al., 2014). Unfortunately, there is a lack of legislation and policy to control the disease. Ethiopian workers' inadequate understanding of the risks and their poor health-seeking behavior have contributed to higher zoonotic transmission in the country.

Health-seeking behavior involves specific steps such as self-care, consulting a family member, visiting a pharmacy, or going to a health center. Individuals may alternate between these resources or use multiple at the same time. Various factors can influence a household's approach to seeking health care. Cultural, religious, socio-demographic, environmental, political, and other issues are the common determining factors identified by various authors (Lépine et al., 2013). Understanding the dairy farmers' knowledge and health service-seeking behavior related to disease symptoms, transmission pathways, prevention and control practices is important to the ability to design an effective disease control strategy, as many diseases are preventable if appropriate prevention and control options are implemented. Unfortunately, this occupationally exposed group needs to be more adequately studied. Specifically, research to

gain information on knowledge about and practices of zoonotic TB prevention, health service-seeking behavior and influencing factors amongst occupationally exposed individuals remains an important requirement to designing all-inclusive, informed zoonotic TB control and other contagious zoonoses. Thus, this study was initiated to identify the existing levels of knowledge and practice on zoonotic tuberculosis and health service-seeking behavior among urban and peri-urban dairy farmers in Ethiopia.

## **MATERIALS AND METHODS**

### **Study design and sampling approach:**

A cross-sectional non-clinical household survey was conducted in 2016 and 2017 in Ethiopia's selected urban and peri-urban dairy farming systems to collect basic information on dairy farm households' exposure to zoonotic diseases. Major cities like Addis Ababa, Mekele, Gonder, Hawasa, Debrezeit, Sululta, Sendafa and Holeta were selected to represent the country's emerging intensive dairy farming areas. The sample size was determined considering the total number of farms and farm sizes as part of a broader epidemiological study of bovine tuberculosis in Ethiopia described by Almaw et al. (2021) and Mekonnen et al. (2019). We used a two-stage stratified sampling technique to select a study location, and within a study location, to sample individual farms. In each selected urban/peri-urban study site, we gathered all the sampling frames (total list of dairy farms) from agricultural department offices. From the sampling frame obtained, we enrolled households using a simple random sampling approach. Four hundred eighty respondents that were actively participating in animal husbandry were selected.

### **Questionnaire administration:**

A semi-structured questionnaire was developed to assess dairy farm workers' knowledge and health-seeking behavior related to bovine tuberculosis. The questionnaire had components to capture participants' sociodemographic characteristics, knowledge and health-seeking behavior. It was administered by face-to-face interviews with trained enumerators who traveled to the selected farms. In addition to the above data, participants' names, mobile phone numbers and other identifiers were collected. All these data were kept confidential and access was regulated by the project management.

### **Data management and analysis:**

The Statistical Packages for Social Sciences (SPSS) version 16.0 was used for the analysis of the data. Descriptive and inferential statistical methods, such as the mean, chi-square test, and logistic regressions, were applied. These methods were used to identify potential correlations and to

measure the intensity of these correlations between the dependent and independent variables. A p-value of less than 0.05 was considered an indication of the presence of a significant association.

## RESULTS

### Socio-demographic characteristics of the participants:

Of the 480 household participants, 366 (76.4%) were males and 113 (23.6%) were females. Most of the interviewed householders (89.5%) had attained education ranging from primary to tertiary level, while 3.5% were able to read and write, and 8% were illiterate. The age of participants ranged from 18 to 92, with an average age of 46.4 years and an average dairy farming experience of 21 years. The respondents' family size ranged from one to 14

**Table 1: Demographic characteristics of participants**

| Question   | Category                     | N   | %     |
|--|------------------------------|-----|-------|
| Respondent's sex                                       | Female                       | 113 | 23.59 |
|  | Male                         | 366 | 76.41 |
| Ownership of the farm                                  | Private                      | 393 | 82.05 |
|  | Government                   | 15  | 3.13  |
|  | Cooperative                  | 57  | 11.90 |
|  | Share                        | 11  | 2.30  |
|  | Other                        | 3   | 0.63  |
|  |                              | No  | 123   |
| Access to livestock extension service                  | Yes                          | 355 | 74.27 |
| Training on livestock husbandry                        | No                           | 186 | 38.83 |
|  | Yes                          | 293 | 61.17 |
| Got any extension service related to zoonotic diseases | No                           | 355 | 74.11 |
|  | Yes                          | 124 | 25.89 |
| Got any extension service related to bovine TB         | No                           | 359 | 74.95 |
|  | Yes                          | 120 | 25.05 |
| Your main source of extension service in livestock     | Government extension service | 330 | 68.89 |
|  | NGOs                         | 31  | 6.47  |
|  | Research centers/University  | 27  | 5.64  |
|  | Other fellow farmers         | 22  | 4.59  |
|  | Other                        | 63  | 13.15 |

N = number

**Table 2: Self-reported disease symptoms due to consumption of raw meat and milk, perceived health status and health-seeking frequency identified by respondents**

| Health status and seeking   | Category   | N              | %    |
|---|--|----------------|------|
| Which symptoms have you had due to consumption of raw meat?         | Tapeworm   | 53             | 52.5 |
|   | Abdominal discomfort                                     | 25             | 24.8 |
|   | Uric acid  | 8              | 8    |
|   | TB   | 7              | 7    |
|   | Amoeba   | 4              | 4    |
|   | Anthrax  | 2              | 2    |
|   |  | Blood pressure | 1    |
| Which disease symptoms have you had due to consumption of raw milk? | Vomiting   | 1              | 1    |
|   | TB   | 25             | 49   |
|   | Abdominal discomfort                                     | 11             | 20   |
|   | Tapeworm   | 7              | 13   |
|   | Amoeba   | 6              | 11   |
| Perceived health status   | Brucellosis  | 5              | 9    |
|   | Excellent  | 162            | 36   |
|   | Very good  | 151            | 33.6 |
|   | Good   | 112            | 24.9 |
|   | Poor   | 25             | 5.6  |
| Frequency of health care-seeking behavior                           | Twice a year or more                                     | 162            | 34   |
|   | Once per year  | 142            | 29.8 |
|   | Less than once a year but at least twice in past 5 years | 91             | 19   |
|   | Once in past 5 years                                     | 44             | 9.2  |
|   | Never in past 5 years                                    | 38             | 8    |

N = Number

**Table 3: Preferred health posts for household health care services**

| N | Preferred health posts                                 | Yes, N (%) | No, N (%)  |
|---|--|------------|------------|
| 1 | Private clinic   | 400(84%)   | 76(16%)    |
| 2 | Government clinic/hospital                             | 386(81.1%) | 90(18.9%)  |
| 3 | Clinic run by a nongovernmental organization or church | 55(11.6%)  | 421(88.4%) |
| 4 | Traditional healers                                    | 66(13.9%)  | 410(86.1%) |
| 5 | Others (holy water, steam bath)                        | 5(1%)      | 471(99%)   |

N = number

**Table 4: Household health-seeking behavior by various determining factors**

| Factors                          | Factor categories | Yes, N (%) | No, N (%) |
|----------------------------------|-------------------|------------|-----------|
| Regions (N=476)                  | Addis Ababa       | 156 (32.8) | 8 (1.7)   |
|                                  | SNNP              | 47 (9.8)   | 5 (1)     |
|                                  | Amhara            | 53 (11)    | 13 (2.7)  |
|                                  | Oromia            | 101(21)    | 33 (7)    |
|                                  | Tigray            | 43 (9)     | 17 (3.5)  |
| Household Health status (N =450) | Excellent         | 125 (27.8) | 37(8.2)   |
|                                  | Very good         | 134(29.8)  | 17(3.8)   |
|                                  | Good              | 100(22.2)  | 12(2.7)   |
|                                  | Poor              | 20(4.4)    | 5(1)      |
| Residence (distance) (N=476)     | Urban             | 299(62.8)  | 43(9)     |
|                                  | Peri-urban        | 101(21)    | 33(7)     |
| Herd size (N= 457)               | Small             | 280(58.8)  | 55(11.6)  |
|                                  | Medium            | 88(18.5)   | 16(3.4)   |
|                                  | Large             | 32(7)      | 5(1)      |
| Education level (N=457)          | Illiterate        | 28(6)      | 6(1.3)    |
|                                  | Primary           | 114(25)    | 23(5)     |
|                                  | Secondary         | 116(25.4)  | 25(5.5)   |
|                                  | Tertiary          | 128(28)    | 17(3.7)   |
| Gender (N=475)                   | Female            | 97(20.4)   | 16(3.4)   |
|                                  | Male              | 303(63.8)  | 59(12.4)  |
| HH SIZE (N=476)                  | 1-5               | 191(40)    | 44(9)     |
|                                  | 6-10              | 177(37.2)  | 25(5.3)   |
|                                  | >10               | 32(6.7)    | 7(1.5)    |
| TB Knowledge (N=476)             | Yes               | 380(79.8)  | 61(12.8)  |
|                                  | No                | 20(4.2)    | 15(3.2)   |
| Employment status (N=416)        | Family member     | 255(61.3)  | 46(11)    |
|                                  | Employee          | 96(23)     | 19(5)     |
| Extension on livestock (N=475)   | Yes               | 302(63.6)  | 50(10.5)  |
|                                  | No                | 97(20.4)   | 26(5.5)   |
| Household Income in Birr (N=476) | Up to 250         | 210(44)    | 49(10.3)  |
|                                  | 251-500           | 104(29)    | 16(3.4)   |
|                                  | Greater than 500  | 86(18)     | 11(2.3)   |

N = number

members, with an average of five members per household. Most participants (82%) were from private farms, followed by cooperatives. Most importantly, many had no training experience in zoonotic diseases, including tuberculosis (Table 1).

#### Self-reported diseases of farm workers:

About 39 (8.1%) respondents reported illness in the two weeks before the interview. The frequently reported illnesses were common cold 16 (41%), abdominal discomfort 7 (17.9%), blood pressure 3 (7.7%) and kidney diseases 3 (7.7%) (Table 1).

About 41% of dairy farmers considered that human diseases could be transmitted from animals through close contact and consuming raw meat and milk. The most common self-reported zoonotic disease symptoms associated with raw meat and milk consumption were anthrax, brucellosis, tuberculosis, tapeworm, abdominal discomfort, vomiting and amoeba. They also perceived high blood pressure, abdominal discomfort, vomiting and uric acid (gout) as chronic disease symptoms due to raw meat and milk consumption (Table 2).

**Table 5: Multinomial logistic regression results of household health-seeking behavior with various risk factors**

| Determining factors          | Coefficient | P-value | 95% Confidence interval |        |
|------------------------------|-------------|---------|-------------------------|--------|
| Region                       | -0.68       | 0.001   | -1.058                  | -0.309 |
| Sex                          | 0.86        | 0.05    | -0.016                  | -1.745 |
| Age                          | -0.02       | 0.18    | -0.037                  | -0.007 |
| Knowledge of tuberculosis    | 1.54        | 0.002   | -0.552                  | 2.529  |
| Household health status      | 0.33        | 0.285   | -0.272                  | -0.923 |
| Level of education           | -0.36       | 0.026   | -0.672                  | -0.042 |
| Income                       | 0.29        | 0.01    | 0.087                   | 0.492  |
| Household size               | 0.36        | 0.232   | -0.234                  | -0.963 |
| Employment status            | 0.08        | 0.874   | -0.945                  | -1.112 |
| Position                     | -0.09       | 0.05    | -0.187                  | -0.002 |
| Earning                      | 0.00        | 0.085   | 0.000                   | -0.001 |
| Residence (urban/peri-urban) | 1.16        | 0.01    | -1.977                  | -0.345 |
| Farm ownership               | -0.46       | 0.022   | -0.846                  | -0.064 |
| Constant                     | 2.03        | 0.135   | -0.637                  | -4.705 |

**Table 6: Knowledge of participants about tuberculosis and its transmission**

| Questions                             | Response      | N   | %    |
|---------------------------------------|---------------|-----|------|
| Do you know about transmission of TB? | Yes           | 444 | 92.7 |
|                                       | No            | 35  | 7.3  |
| Transmission from animal to animal?   | Yes           | 377 | 79.7 |
|                                       | No            | 26  | 5.5  |
|                                       | I do not know | 70  | 14.8 |
| From human to human?                  | Yes           | 450 | 95   |
|                                       | No            | 9   | 2    |
|                                       | I do not know | 14  | 2.96 |
| From animals to human?                | Yes           | 352 | 74.4 |
|                                       | No            | 40  | 8.5  |
|                                       | I do not know | 81  | 17   |
| From human to animal?                 | Yes           | 161 | 34   |
|                                       | No            | 132 | 28   |
|                                       | I do not know | 180 | 38   |

N = number

#### **Household healthcare-seeking behavior, perceived health status and health post preference:**

This study was not based on clinical analysis of subjects' health status, which could be a limitation in providing full information on household health-seeking behavior. However, respondents could give information on their health-seeking behavior, perceived health status and health service preference. Accordingly, 162 (36%) of participants reported that they had excellent health, 151 (33.6%) very good health and 112 (25%) good health, while 25 (5.6%) reported poor health. Most (84%) participants responded positively to health seeking. Furthermore, 32.5% of the participants sought health care twice yearly or more (Table 2).

Private health facilities were preferred by the greatest number of respondents, followed by government clinics/hospitals, NGO clinics, traditional healers, and home remedies (Table 3). This study found no association between health-seeking behavior and gender, even though 69.5%

of male dairy farmers sought healthcare services compared to 22.5% of females. About 35% of the respondents practiced treating their illness themselves and went to traditional healers before seeking modern health care services. The average cost for one treatment in a private clinic was 538 ETB (Ethiopian birr) compared to 22 ETB in government clinics/hospitals. Self-treatment had little or no cost except for medicinal home remedies that were not available in their home garden. The average price required for one treatment in a private clinic was much more costly than for government clinic/hospital or self-treatment.

Further, 96.2% of the households covered their own medical costs, and the remaining 3.8% covered their medical costs through free medical services, or at employer's or relative's expense (Table 4). Dairy farmers in urban areas had better health service-seeking behavior than those in peri-urban areas. Region-wise, health-seeking behavior was highest among those from Addis Ababa (33%), followed by Oromia (21%), Amhara (11%),

**Table 7: Practice of TB prevention approaches by respondents (How can a person prevent himself/herself from getting TB?)**

| How can you prevent TB?                             | Yes, N (%) | No, N (%) | I don't know, N (%) |
|---|------------|-----------|---------------------|
| Covering mouth and nose when coughing or sneezing   | 452 (94)   | 15 (3)    | 12 (3)              |
| Avoiding sharing dishes                             | 323 (67)   | 94 (20)   | 60 (13)             |
| Avoiding hand shaking                               | 124 (26)   | 279(58)   | 72(15)              |
| Washing hands after touching items in public places | 320 (67)   | 92 (19)   | 65 (14)             |
| Closing windows at home                             | 162 (39)   | 250 (52)  | 67 (14)             |
| Eating good food                                    | 328 (69)   | 59 (12)   | 92 (19)             |
| Avoiding consumption of raw milk                    | 338 (71)   | 46 (10)   | 95 (20)             |
| Avoiding consumption of raw meat                    | 328 (69)   | 50 (10)   | 101(21)             |
| Avoiding contact with infected animals              | 288 (60)   | 56 (12)   | 135 (28)            |
| Others  | 10 (2)     | 248 (52)  | 220 (46)            |

TB = Tuberculosis; N = number

**Table 8: Multinomial logistic regression analysis result of household knowledge on zoonotic tuberculosis**

| Determining Factors | Coefficient | P-value | 95% Confidence interval |       |
|---------------------|-------------|---------|-------------------------|-------|
| Residence           | 0.1         | 0.837   | -0.84                   | 1.04  |
| Household size      | -0.63       | 0.03    | -1.19                   | -0.06 |
| Level of education  | 0.79        | 0.001   | 0.48                    | 1.09  |
| Farm Health status  | -1.05       | 0.049   | -2.10                   | 0.01  |
| Constant            | 2.03        | 0.014   | 0.41                    | 3.66  |

SNNP 47 (10%) and Tigray (9%). Educated individuals had better health-seeking behavior than those with less or no education. About 28% of those with tertiary education performed health-seeking behavior, followed by secondary (25.4%) and primary education (25%). Illiterate farmers accounted for only 6% of health-seeking behavior (Table 4). Dairy farmers with knowledge and awareness of tuberculosis, access to livestock extension services and better income sought modern health services more frequently than others. The variation in the modern health-seeking behavior of households that had awareness about tuberculosis and had access to livestock extension was statistically significant (Table 5).

#### Dairy farmers' knowledge, perception and practices related to tuberculosis:

About 93% of respondents were aware of tuberculosis transmission from human to human, while 76.8% and 71% were aware of transmission from animal to animal and animal to human, respectively (Table 6). Most farm workers knew the common symptoms of tuberculosis in humans. About 30% and 33% of the respondents considered raw meat and raw milk significant sources of tuberculosis infection, respectively. In addition, 5% and 7.2% of the respondents mentioned close contact with infected animals and respiratory routes as sources of tuberculosis infection, respectively (Table 7). Regarding preventing

tuberculosis transmission from human to human, 94.4% of the respondents practiced covering their mouth and nose when coughing and sneezing, and 68.5% mentioned that eating good food was the common practice of the households in the study dairy farms. The multinomial logistic regression analysis indicated that household size, level of education, and farm health status determined their knowledge of tuberculosis (Table 8).

#### DISCUSSION

Bovine tuberculosis, a disease of significant zoonotic importance, is widely prevalent in Ethiopia, leading to substantial health challenges and economic losses. This study evaluated the comprehension of dairy farmers regarding bovine tuberculosis, its zoonotic significance, and their associated practices and health-seeking behaviors. Of the total 481 participants, more than 75% were males. Males dominated livestock-related activities, which aligns with a study conducted in southeastern Ethiopia (Begashaw et al., 2016), in which 72% of respondents were males. Although males dominate most farming activities in Ethiopia and many low- and middle-income countries, females also have an important role in one or another task, so gender-sensitive training schemes are required to control TB and other vital zoonoses. Most importantly, many had no training experience in zoonotic diseases, including tuberculosis. Only 25% of the participants had had

training from government organizations throughout their dairy farming experience, which might contribute to this group's better understanding of the importance of preventing tuberculosis. The extension service preventing and controlling significant zoonoses in Ethiopia has yet to be well practiced. Training is the first step to changing farmers' knowledge, attitude and practice in peri/urban settings where most of the supply to urban consumers is produced.

The health-seeking behavior varied among regions, residences, and according to the health status of the respondents, their education level and sex. Since illness is the driving force for health service-seeking and utilization, the health status of the household and the severity of the illness can determine health-seeking behavior. Adler & Stead (2015) identified similar factors like residence, cost of service, household income, the distance of the clinic, availability of health care service, waiting time for health-seeking behavior, and choice of health posts. All patients seek private health services and, at the same time, government and traditional healers. This could be because of different socioeconomic, cultural and religious factors among the participants.

Some of the respondents (14%) sought help from traditional healers, among which 11% were from urban and 21% of the households from peri-urban settings, including herbalists and healers using holy water. This study result is similar to Amare et al. (2012), Amin et al. (2010) and Goli et al. (2018). Many individuals in developing countries, including Ethiopia, prefer to explore traditional treatment methods before resorting to contemporary health care services, primarily to evade potential stigma. For instance, due to the fear of ostracization by friends and family, people often refrain from seeking modern health services and professional advice for prolonged periods, especially in cases of HIV and TB.

Overall, dairy farmers had a relatively high level of awareness about tuberculosis. More than 92% knew about the disease and its transmission and health burden in general. However, there is still room for improvement, particularly in understanding the reverse zoonotic nature of bovine tuberculosis and the specific sources of infection. Only 34% knew that bovine tuberculosis could be transmitted from humans to animals, which contrasts with a previous study that found a much lower level of awareness (15%) among cattle owners in Mekelle City (Fikre et al., 2014). This could be because of the difference in access to information about the prevalence of bovine tuberculosis in crossbred cows.

Most of the well-understood paths of bovine tuberculosis transmission paths were known by

interview respondents. However, a significant number of them had a thing or two to learn about the transmission of the disease. They responded 'I don't know' or believed wrongly about some paths of disease transmission. This indicates that much of the disease's burden can be reduced with cost-effective educational campaigns aimed at increasing understanding routes of transmission and prevention and control approaches. The association between knowledge of householders about tuberculosis with their demographic information was done with multinomial logistic regression; we found that it has a statistically significant association with household size, level of education, and farmer's health status. This result aligns with the findings of Abebe et al. (2010), who reported that knowledge of tuberculosis and health service-seeking behavior in Ethiopia related to sociodemographic variables such as education and household size. When an individual has advanced education, his/her understanding of the zoonotic potential of tuberculosis also increased.

In conclusion, dairy farmers' knowledge and awareness level about bovine tuberculosis and its zoonotic nature, sources of infection, prevention and control in animals and humans was marginally satisfactory. However, they still need a clearer understanding of the potential of reverse zoonoses. With dairy farmers' full understanding of the nature of the diseases, treatment, prevention and control of tuberculosis are easier. Educational campaigns to risk groups about the disease are probably the least expensive way to reduce the public health burden of tuberculosis on the country. Hence, awareness-creation schemes on routes of bovine tuberculosis transmission, sources of infection, and prevention methods for dairy farmers are highly desired.

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#### **Data availability statement:**

Data are available from corresponding author on reasonable request.

#### **Declarations:**

#### **Ethics approval and consent to participate:**

The participants of the study were verbally informed about the purpose of the study, type of information to be sought during the interview, risks and benefits, confidentiality, the right to withdraw from the study, and additional study-related information. Verbal consent was sought from the household before the interview. Participation was based on their willingness to participate, and participants could stop at any time without any obligation during the discussion or interview if they felt uncomfortable. Ethical clearance was obtained from AHRI-ALERT Ethics Review Committee (Project Reg. No. PO46/14) and Ethiopia's National Research Ethics Review Committee (NRERC No. 3.10/800/07) from September 2014 to January 2022.

#### Consent for publication:

The authors have provided their consent for publication.

#### Competing interests:

The authors declare that they have no competing interests.

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