Assessment of dairy farm's hygienic practice and knowledge of farm workers on milk-borne zoonoses in three selected towns of the Wolaita Zone, Southern Ethiopia

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Abstract

Consumption of unhygienic milk is the most common source of milk-borne zoonotic diseases. These zoonoses have public health importance and are a major obstacle to trade in livestock and livestock products. A cross-sectional questionnaire-based study was conducted from December 2021 to June 2022 to assess milk-borne zoonotic diseases, the habit of milk consumption, and the hygienic practices of dairy farm workers in three purposefully selected towns in the Wolaita zone, southern Ethiopia. Dairy farms and farm workers were selected by a simple random sampling technique. A total of 100 respondents, one per farm, were selected and participated in the interview. The result indicated that 41% of farms used individual towels and 21% used common towels to dry their cows' udders; however, the remaining 38% of farms did not use any towels at all. The majority (59%) of farms clean the floor once a day and around 92% remove dung manually. Of total farm workers, 43% had no formal education, 28% had primary-level education, 5% had secondary-level education, 2% were college diploma holders, and 22% were first-degree and above graduate workers. Concerning milk consumption habits, 64% of respondents used raw milk, 29% used raw and boiled milk, 3% of interviewees consumed all types of milk (raw, boiled, refrigerated, and processed milk), and 4% didn't drink milk at all. Furthermore, 50% of respondents were aware of disease transmission through the consumption of raw milk. Regarding respondents' knowledge of milk-borne zoonoses, 51% of interviewees didn't know about zoonotic diseases, while the remaining 4% knew about tuberculosis, 32% were aware of salmonellosis, 5% knew about both tuberculosis and salmonellosis, and 8% were aware of tuberculosis, anthrax, mastitis, salmonellosis, and brucellosis. Concerning the knowledge of respondents on disease transmission, 73% of respondents didn't know that zoonotic diseases can transmit from humans to animals and vice versa. Furthermore, when compared to other educational levels, partici-

pants with a degree or higher (86.7%) had better awareness of disease transmission from raw milk consumption, and there was a statistically significant difference (p-value < 0.05). The farms had poor awareness of dairy farm hygienic standards and milk-borne zoonoses. To lessen the animal and public health concerns associated with milk-borne zoonoses, it is critical to create awareness, provide extension services, and provide training programs.

Keywords: Dairy farm; knowledge; milk-borne; milking hygiene; zoonoses.

Introduction

Globally, the livestock sector is highly dynamic and contributes 40% of the global value of agricultural output and supports the livelihoods and food security of almost a billion people (Thornton, 2010). The Ethiopian total cattle population is estimated to be about 70 million and the agricultural sector engaging 80% of the population, contributes 52% of the gross domestic product (GDP) and 90% of the foreign exchange (CSA, 2021; Stoltenow *et al*., 2013). The livestock sub-sector alone contributes 12% of the total and over 45% of the agricultural GDP, and over 85% and 90% of the farm and pastoral incomes respectively (Amanuel and Ulfina, 2018).

Dairy production, in the livestock production sector, is a critical issue in Ethiopia; because it is among the main sources of food and income (Birhanu *et al*., 2022). In such sceneries, people have close interaction with animals and animal products. In developing countries like Ethiopia, the dairy sector has a greater potential especially in poverty alleviation by increasing the income of dairy producers and improving the living standards of people, improving nutrition arising from milk consumption and creating employment, and transforming the existing largely subsistent type of milk production to commercial level (Njombe *et al.,* 2011; Yilma *et al*., 2011). However, milk is a highly perishable commodity and highly nutritious food and serves as an ideal medium for the growth and multiplication of various microorganisms (Parekh and Subhash, 2008). Infections that are naturally transmissible from vertebrate animals to humans and vice-versa are classified as zoonosis (WHO, 2019). These zoonoses can be transmitted to humans in several ways that include consumption of infected raw or unpasteurized milk and milk products (mostly) and contact with infected dairy animals

and products and infected farm environments (Bertu *et al*., 2010; Birhanu *et al*., 2022).

Considering the high burden of zoonotic diseases in Ethiopian livestock, the community is at risk of zoonotic transmission through inhalation and ingestion of pathogens. Consumption of uncooked or unprocessed food increases the risk of disease transmission (Deneke *et al*., 2022). According to estimates for the burden of zoonotic diseases, infections discovered in milk are responsible for around 61% of human infections and 90% of diseases associated with consuming dairy products. Some of the microbial contaminants are responsible for milk spoilage while others are pathogenic with potential health effects which cause milk-borne diseases (Weldekidan *et al*., 2019).

Contamination of milk and milk products with pathogenic bacteria is largely due to handling, processing, and unhygienic conditions (Maity *et al*., 2010). Animal-source foods have been found guilty of the majority of food-borne diseases (De Buyser *et al*., 2001) and incidences increase with increasing access to such foods, especially without adequate hygiene, inspection for safety, or satisfactory heating for killing pathogens (McCrindle, 2008). The common raw milk zoonotic bacterial diseases are Brucellosis, bovine Tuberculosis, Salmonellosis, Anthrax, Mastitis, Campylobacterosis, etc. (Weldekidan *et al*., 2019).

Milk and other dairy products are produced in unhygienic settings in developing countries, and milk and dairy products, in general, have poor hygiene standards (Yilma *et al*., 2007). According to the National Hygiene and Sanitation Strategy program (WHO, 2019), Ethiopia's poor hygiene and sanitation are responsible for more disease burden. Currently, a large number of dairy productions are operating in and around Wolaita Sodo Zone, using improved dairy breeds. However, knowledge of farm hygiene practices and farmers' awareness of zoonoses carried by cow's milk is still poor. This results in public health risks and economic losses affecting the livelihoods of dairy producers. Hence, an understanding of farmers' knowledge of milking hygiene and cattle milk-borne zoonoses is very important to reduce the risk of cattle milk-borne zoonoses transmission. Therefore, the objectives of this study were to assess the hygienic practice of dairy farms that include dairy house hygiene, udder cleaning, and milk handling; and to assess the awareness of milk-borne zoonotic diseases and the habit of raw or unpasteurized milk consumption and associated risk factors in three selected towns of Wolaita zone, Southern Ethiopia.

Materials and methods

Study area

The study was conducted in three selected towns (Sodo, Boditi, and Areka) of the Wolaita Zone, southern Ethiopia. Sodo town, the capital of Wolaita Zone, is situated 390 kilometers south of Addis Ababa, the capital of Ethiopia. The town is located at a latitude of 8°50°N and a longitude of 37°45°E, with an altitude of 2025 meters above sea level. The town has a mean annual temperature of 20°C, receives rainfall of 450–1446 mm, and has minimum and maximum daily temperatures of 12 and 25°C. On the other hand, Boditi town is found 18 km north of Sodo town, at 37° 52' E and 6.967°N. Boditi has an average rainfall of 1000mm and temperatures ranging from 26°C in January to 11°C in August. Areka town is located 29 kilometers west of Wolaita town at longitude 37° 47' E and latitude 7°4′ N. The average rainfall is 1538.44 mm, and the temperature ranges from 14.48°C to 28.5°C (WZAO, 2017).

Study population

The study populations were dairy farms and farm workers from three purposefully chosen towns in the Wolaita zone. The three towns were projected to have 175 dairy farms available. Each dairy farm employed eight (8) workers on average. The study covered dairy farms of all sizes, including small, medium, and large-scale operations. Only one dairy farm worker per dairy farm was interviewed in each dairy farm about hygienic practices on the farm and knowledge of milk-borne zoonotic diseases. According to Arnett (2007), the respondents' ages were categorized into four groups: 18–25, 26–35, 36–50, and >50 years.

Study design

A cross-sectional questionnaire-based study design was conducted by collecting data through structured questionnaires. From the selected farms, only one farm worker was selected in each farm. The questionnaire was generally divided into two sections: 1) general information and hygiene practices of dairy farms; and 2) specific questions about zoonotic illness, and milk consumption patterns of farm workers. The first section of the questionnaire was supported by another unselected worker who had more information in the case when the selected worker did not have complete information about the farm. But the second part of the questionnaire, which related to personal perceptions about

zoonotic diseases and milk consumption habits, was only filled out by selected individuals.

Sampling technique and sample size determination

Dairy farms and farm workers were chosen using simple random sampling methods, but the three towns were chosen purposefully based on the prevailing numbers of dairy farms. The sample size was calculated according to Yamane (1967). The current study comprises a randomly selected dairy farm that is found in Sodo town, Areka, and Boditi.

$$n = \frac{N}{1+ (N (e^2))}$$

Where n is the sample size of the study; N is the total number of farms; e is the maximum variability or margin of error of 5% (0.05); and 1 is the probability of the event occurring. Therefore, a total farm was selected at a 5% standard error with a 95% confidence interval. However, 100 dairy farms were chosen for this study based on the owners' willingness, time, and resources.

Method of data collection

A questionnaire-based survey was carried out by asking and observing dairy farm characteristics, followed by specific questions related to the assessment of the hygienic practices of dairy farms and their awareness of milk-borne zoonosis diseases. A structured questionnaire was prepared to assess the hygienic measures of dairy farms and their knowledge of milk-borne zoonosis on selected dairy farms in the study areas. During the questioning and distribution of the questionnaire to the dairy farm workers, it was appropriately translated into the local languages of "Wolaitgna" and "Amharic."

Data management and statistical analysis

The collected raw data were stored, coded in a personal computer's Microsoft Excel spreadsheet program, and analyzed using STATA statistical software version 14. Descriptive statistics such as frequencies, distributions, and percentages were used to summarize the data. Pearson's chi-square test was used to detect the existence of an association between different demographic risk

factors such as age, sex, farm owners, and educational status and outcome variables like milk consumption habits and transmission of disease by raw milk consumption. Besides, a p-value of less than 0.05 was considered statistically significant.

Ethical clearance

All interviewees gave their informed consent for inclusion before they participated in the study. The study protocol was approved by the Wolaita Sodo University Research Ethics and Review Committee with reference number WSU 41/22/2241, and the verbally informed consent process was documented in the manuscript. The best practices for veterinary care were followed, and those who owned the farms were informed of the objective of the research and that the protocol had been approved.

Results

Socio-demographic characteristics

The study revealed which categories of dairy farm workers were greater in number at the farm level in terms of gender and level of education. Out of the total farms selected, 48% had more female than male employees, 29% had more male than female employees, and 23% had an equal number of male and female employees. Regarding the educational levels of dairy farm workers, 43% of farms had a majority of workers with no formal education, 28% had a primary education level, 5% had a secondary education level, 2% had college diplomas, and 22% of respondents had a first degree or higher. (NB: Dominance of workers' gender and educational status at the farm level has been addressed even in the case of a plus-one worker). Regarding farm working experience, 10% had less than five years, 31% had between 6 and 10 years, 8% had between 11 and 15 years, 9% had between 16 and 20 years, and 42% had above twenty years of experience (Table 1).

Table 1. Socio-demographic characteristics of respondents and farms

Questions/ variables	Category	No of Farms	Frequency (%)	95% CI
Farm owners	Family	95	95.0	88.38 - 97.93
	Private	3	3.0	0.95 - 9.05
	Government	2	2.0	0.48 - 7.81
Which gender is predominant among the farm's employees?	Female workers	48	48	38.24- 57.9
	Male workers	29	29	20.8 – 38.7
	An equal number of both genders	23	23	15.68 – 32.5
Which educational levels prevail in numbers on the farm?	No formal education	43	43	33.5 - 53.1
	Primary education	28	28	19.9 – 37.7
	Secondary education	5	5	2.06 - 11.61
	Diploma holder workers	2	2	0.48 - 7.81
	Bachelor's degree and above	22	22	14.8 – 31.4
Dairy farm working experiences (years)	< 5	10	10.0	5.40 - 17.76
	6-10	31	31.0	22.59 - 40.87
	11-15	8	8.0	4.02 - 15.35
	16-20	9	9.0	4.69 - 16.56
	>20	42	42.0	32.58 - 52.03
Age of respondents (years)	18-25	21	21.0	14.00 - 30.25
	26-35	17	17.0	10.75 - 25.83
	36-50	60	60.0	49.95 - 69.26
	>50	2	2.0	0.48 - 7.81

CI: Confidence interval; No: number

Dairy farms' breed composition

The majority of farms featured different breed types rather than just one breed of the animal when it came to the breeding makeup of farms. Out of all farms, 22% had a larger percentage of crossbred animals, 52% had a higher percentage of Holstein Frisian, 3% had a higher percentage of Jersey breeds, and the remaining 23% had a local breed predominate.

Hygienic practices of dairy farmhouses

The study showed that 53% of the dairy farms' house floors were made of concrete, which was washable, and 47% were not washable. Regarding house cleaning, 59% of farms cleaned the floor once a day, 21% cleaned twice a day, 15% cleaned thrice a day, and only 5% cleaned more than thrice a day. From the total farms, 92% removed dung manually, 4% used hose water for mixing to drain by itself, and the remaining 2% used both of these methods. Out of all the farms, 49% removed fluid waste manually, 46% utilized hose water to drain by itself, and the remaining 5% employed both methods (Table 2).

Feeding, watering, hygiene, and health care

Regarding feeding methods, 59% of farms used indoor feeding, 5% outdoor feeding techniques, and 39% mixed feeding approaches. Although the majority of the farms used indoor feeding systems, most animals (77%) fed on the ground, while only 23% used feeders. The majority of farms (88%) had access to piped water, while only 1% of farms used groundwater. Some farms (11%) used river water for cleaning and drinking. A total of 61% of farms provided water for each animal separately, while 39% provided water for all animals in common (Table 2).

Table 2. Feeding, watering, and cleaning of dairy cows in the study areas

Variable	Category	No of respondents	Percent (%)	95% CI
Feeding	Grazing	5	5.0	2.06 - 11.61
	Indoor feeding	56	56.0	45.99 - 65.54
	Mixed	39	39.0	29.81 - 49.03
Feeding on	On floor	77	77.0	67.57 - 84.31
	In feeder	23	23.0	15.68 - 32.42
Water source	River	11	11.0	6.13 - 18.94
	Underground water	1	1.0	0.13 - 6.97
	Pipe water	88	88.0	79.87 - 93.12
How water given	Individual	61	61.0	50.96 70 .18
	Common	39	39.0	29.81 49.03
Type of floor	Washable	53	53.0	43.05 62.70
	Nonwashable	47	47.0	37.29 56.94
Frequency of cleaning	Once a day	59	59.0	48.96 68.33
	Twice a day	21	21.0	14.00 - 30 .25
	Thrice a day	15	15.0	9.16 - 23.57
	> Thrice a day	5	5.0	2.06 - 11 .61
Dung removal	Manually	94	94.0	87.12 - 97 .31
	Use of hose water for mixing to drain by itself	4	4.0	1.48 - 10.33
	Both	2	2.0	0.48 - 7.81
Urine and other fluid removal	Manual	49	49.0	39.19 - 58.87
	Use hose water to drain by itself	46	46.0	36.34 - 55.96
	Both	5	5.0	2.06 - 11.61

The findings showed that 68% of farms had cleaners and milkers in different ways, compared to 32% of farms that used the same personnel for both jobs. Out of all farms, 66% of milkers washed their hands with only cold water, 16% with cold water and detergent, 2% with only warm water, and 1% with warm water and detergent. In terms of cleaning the udder and teat, 37% of farms used only cold water, 46% used warm water, and 17% of farms used nothing at all. The study also reported that 41% of farms used individual towels for each cow, 21% used common towels for drying the udder after washing, and the

remaining 38% didn't use towels at all for drying. Only 3% of farms reported using disinfection for udder and teat cleaning after milking cows and the majority of farms (97%) did not practice antiseptic for teat disinfection after milking (Table 3).

Table 3. Hygiene and health care of cows on farms

Variable	Category	No of respondents	Percent (%)	95% CI
Do you wash cows?	Yes	56	56.0	45.99 - 65 .54
	No	44	44.0	34.45 - 54.00
Frequency of dairy cow washing	Once a week	28	28.0	19.96 - 37.74
	Twice a week	16	16.0	9.95 - 24.70
	Thrice in week	7	7.0	3.33 - 14.12
	> Thrice a week	2	2.0	0.48 - 7.81
	Do not wash	47	47.0	37.29 - 56.94
Do you use a towel	Yes	58	58.0	47.96 - 67.41
	No	42	42.0	32.58 - 52. 03
How you use a towel	Individually	41	41.0	27.98 - 47.02
	Commonly	21	21.0	36.34 - 55.96
	Do not use	38	38.0	10.75 - 25 .83
What do you use to clean udder	Cold water only	37	37.0	27.98 -47.02
	Warm water only	46	46.0	36.34 - 55.96
	Do not wash udder	17	17.0	10.75 - 25 .83
Milk stored	Refrigerated	13	13.0	7.62 - 21.28
	As milked	87	87.0	78.71 - 92 .37
Milkers and cleaner	The same	68	68.0	58.08-76.51
	Separate	32	32.0	23.48 -41.91
Protective cloth on the farm	Use	17	17.0	10.75 -25.83
	Do not use	83	83.0	74.16- 89.24
Milkers clean their hands before milking	Yes	68	68.0	58.08-76.51
	No	32	32.0	23.48-41.91

Hygienic practice of milk storage and milking equipment

The results of the study indicated that 51% of farms filtered milk during storage, whereas 49% didn't. 58% of farms used plastic to store milk, 15% used metal, and 27% used traditional equipment. On farms, 22% washed milking equipment using cold water alone, 44% with cold water and detergent, 5% with warm water alone, and 29% with warm water and detergent. Only 13% of all farms kept their milk in refrigerators, while 87% kept it at room temperature.

Milk consumption habits and awareness of milk-borne zoonotic diseases

Concerning milk consumption habits, 64% of respondents reported they consumed raw milk, 29% answered they consumed both raw and boiling milk, 3% claimed they used any kind of milk, including raw, boiled, refrigerated, and processed milk, and 4% stated they did not consume any milk at all. The results of the survey indicated that 50% of respondents were aware that consuming raw milk could transmit disease. In terms of interviewees' perceptions and knowledge of milk-borne zoonotic diseases, only 4% were aware of tuberculosis (TB), 32% were aware of salmonellosis, 5% were aware of both TB and salmonellosis, and 8% were aware of TB, anthrax, mastitis, salmonellosis, and brucellosis. The remaining 51% were unaware of zoonotic diseases. Only 27% of interviewees were aware that zoonotic diseases can be spread from animals to humans, and 73% of respondents were unaware that zoonotic diseases can be spread from humans to animals and vice versa. Only 2% of respondents had a history of milk-borne illness, compared to 98% of respondents who were unaware they had it (Table 4).

Table 4. Respondents' milk consumption habits

Variable	Categories	No of respondents	Percent (%)
Do you consume milk	Yes	97	97.0
	No	3	3.0
Consuming habits	Do not consume milk	4	4.0
	Consume raw milk	64	64.0
	Consume raw and boiled milk	3	3.0
	Consume raw, boiled, refrigerated, and processed milk	29	29.0
Know disease transmitted via raw milk consumption	Yes	50	50.0
	No	50	50.0
Do you know the name of milk-borne zoonotic diseases	Don't know	51	51.0
	Tuberculosis	4	4.0
	Salmonellosis	32	32.0
	Tuberculosis, Salmonellosis	5	5.0
	Tuberculosis, Anthrax, Mastitis, Salmonellosis, Brucellosis	8	8.0
Experience in acute raw milk consumption illness	Yes	2	2.0
	No	98	98.0
Milk of sick animal	Discarded	41	41.0
	Given to calves	11	11.0
	Use after processes	23	23.0
	Use without processing	25	25.0
Milk of drug-treated animals	Discarded	41	41.0
	Given to calves	10	10.0
	Use it after processing	18	18.0
	Use without processing	31	31.0

The association of milk consumption habits with different demographic characteristics like sex, age, educational level, and farm experience was assessed. Accordingly, 81.2% of respondents who had no formal education consumed raw milk as compared to other educational levels (Table 5).

Table 5. Association of socio-demographic factors with milk consumption habits

Variable	Category	Responses in percent (%)				X^2	P-value
		Raw	Not consume	Raw and boiled	Raw, boiled, refrigerated, processed		
Sex	Male	64.0	4.0	30.0	2.0	0.368a	0.947
	Female	64.0	4.0	28.0	4.0		
Age (in years)	18-25	76.2	4.8	9.5	9.5	10.780	0.291
	26-35	64.7	5.9	23.5	5.9		
	36-50	60.0	3.3	36.7	0.0		
	>50	50.0	0.0	50.0	0.0		
Educational status	No formal Education	81.2	6.2	12.5	0.0	19.489	0.077
	Primary Education	67.7	3.2	25.8	3.2		
	Secondary Education	46.7	0.0	53.3	0.0		
	Diploma	57.1	0.0	42.9	0.0		
	Degree and above	40.0	6.7	40.0	13.3		

Comparing disease transmission from raw milk consumption with risk factors

Different socioeconomic characteristics were compared with disease transmission from raw milk consumption; as a result, 86.7% of respondents with a degree or higher had a good perception compared to those with other educational levels, and there was a statistically significant difference (p-value < 0.05). Female respondents had higher knowledge (56%) than male respondents (44%) about disease transmission through raw milk consumption (Table 6).

Table 6. Interviewees' knowledge of disease transmission by the intake of raw milk

Variable	Category	Know disease transmission from raw milk consumption		X^2	P-value
		Yes (%)	No (%)		
Owner	Family	48.4	51.6	2.428a	0.297
	Enterprise	66.7	33.3		
	Government	100.0	0.0		
Sex	Male	44.0	56.0		
	Female	56.0	44.0		
Age (in years)	18-25	38.1	61.9	4.328	0.228
	26-35	35.3	64.7		
	36-50	58.3	41.7		
	>50	50.0	50.0		
Education status	No formal Education	18.8	81.2	30.345	0.000
	Primary Education	41.9	58.1		
	Secondary Education	80.0	20.0		
	Diploma	85.7	14.3		
	Degree and above	86.7	13.3		

Discussion

Milk is a complete food that is high in protein and contains all the required amino acids. Despite this, milk can act as a possible route for the spread of various diseases under certain conditions. A questionnaire-based survey of 100 dairy farm respondents was undertaken. Out of all the farms included in the study, 48% had more female employees than males, 29% had more male employees than females, and 23% had an equal number of male and female employees. The current study was similar to a report from Jinka by Abebe *et al.* (2020) and from Dilla by Hailemariam *et al.* (2022), in which 58.23% and 60.8% of milk-handling participants were female, respectively. Similarly, Bereda *et*

al. (2012) in the Gurage zone's Ezha district found that 48% of respondents were female workers.

The present study, however, did not support data from Addis Ababa (Belay and Geert, 2016) and northwest Ethiopia (Yitaye *et al*., 2008), which found that farms employed more men than women. In a study conducted in Tanzania, 27% of respondents were female (Omore *et al*., 2021), which was lower than the percentage of female workers in the current study. The present study was lower than the previous report by Azage (2004), in which most of the respondents (75.9%) were male as compared to female workers. This discrepancy might be due to females being more prone to milking and caring for animals than males.

In terms of dairy farm worker's educational backgrounds, 43% of farms had a majority of employees without a formal education, 28% had a majority of employees with a primary education level, 5% had a majority of employees with a secondary education level, 2% had a majority of employees with college degrees, and 22% had a majority of employees with a first degree or higher. Due to lower wages, a large number of workers without a formal education were working on the farm, and most farm owners do not welcome educated people to work on their farm.

According to the current study, 53% of the dairy farms' house floors were washable concrete, whereas 47% were not. This finding was consistent with previous reports in Addis Ababa (Bruktawit, 2016), Bishoftu (Lencho and Seblewongel, 2018), and Jimma, eastern Ethiopia (Belay and Geert, 2016), where most cows were confined to concrete floors; however, the study disagreed with a previous report in Dire Dawa, eastern Ethiopia, where the major floor structure of cattle sheds was hardened soil (Emebet and Zeleke, 2008). In terms of housekeeping, 59% of farms cleaned the floor once per day, 21% cleaned it twice per day, 15% cleaned it three times per day, and just 5% cleaned it more than three times per day. This was similar to the report from Mukaturi and Sululta towns (Sema *et al*., 2019), in which 55.9% of farms cleaned the floor once a day and 44.1% cleaned twice a day, but the current study differed from the findings reported in Addis Ababa that the floor or barn on 74.3% of dairy farms was washed daily, and some farms (25.7%) were cleaned three times a week (Fufa *et al*., 2019). This demonstrated a lack of knowledge regarding farm hygiene in the current study farms.

According to the current survey, 92% of farms removed manure manually, 4% utilized deranges, and the remaining 2% employed both deranges and hand removal. In terms of fluid waste, 49% of farms eliminated it manually, 46% used a deranged system, and the remaining 5% used both techniques. This finding contradicted the previous research in Sodo (Enkeshe, 2020), in which dung was completely removed by hand while fluid was eliminated by derangement. This revealed that manually removing dung takes time and puts the person doing the removal at risk.

In terms of feeding systems, the majority of farms (59%) utilized indoor feeding systems, 39% used mixed feeding systems, and only 5% used outdoor feeding systems. Although most farms use indoor feeding systems, this differs from the previous study, which found that 63.3% of farms used outdoor grazing, 30% used indoor feeding systems, and only 6.7% used mixed feeding systems (Oumer *et al*., 2017). This disparity could be attributed to a scarcity of farmland.

According to this study, 77% of farms fed on the floor, while just 23% fed on the feeder. This result was consistent with the findings of Enkeshe (2020) in Sodo, where 77.3% of farms were fed on the floor and 22.6% on the feeder. This could be because dairy production has received a lot of attention and funding. In terms of water supply, 88% of farms had access to piped water, while only 1% used groundwater. The river water was used for cleaning and drinking by 11% of farms. Sixty-one percent of farms provided water for each animal separately, while 39% provided water for all animals collectively. This finding was consistent with the findings of Alebachew and Alemu (2015), who found that 91.7% of commercial dairy farms in Addis Ababa used pipe water as their primary source to clean and supply cow farms, whereas 8.3% used river water. Similarly, a study in Dilla, Gedeo Zone, by Hailemariam *et al*. (2022) reported that dairy farmers used two sources to water their cattle, either from the river (54.3%) or from pipes (45.8%) and also (Tesfaye and Wondossen, 2019) for Gurage Zone and (Bekuma and Addisu, 2021) for Buno Bedele Zone, which have all indicated such water sources. This study contradicted the findings of Bereda *et al*. (2012), who discovered that the majority of dairy cow producers in the Gurage zone used river and hand-dug well water, which may not be of the required standard.

According to our findings, 68% of farms used separate cleaners and milkers, while 32% used the same staff for both tasks. Sixty-six percent of milkers on all

farms used only cold water to wash their hands; sixteen percent used cold water and detergent; two percent used warm water alone; and one percent used warm water and detergent. To clean the udder and teats, 37% of farms used just cold water, 46% used warm water, and 17% used no water at all. According to Duguma and Geert (2015), the majority (96.3%) of Jimma respondents practiced hygienic milking, which included washing hands, milk containers, and udders before milking. The study also found that 41% of respondents used individual towels and 21% used common towels to dry the udder after washing before milking, while the remaining 38% did not. In this study, the majority of farms (97%) did not use antiseptic for teat cleaning after milking, and just 3% disinfected udders and teats after milking cows. This was in line with a study in Mersa Town, North Wollo, in which most dairy farm owners (65%) did not sufficiently perform cleaning of cow's udder and teat even with potable water and did not dry it properly (Oumer *et al*., 2017). This could be because farm owners and staff in the research area are unaware of proper hand washing and udder disinfection. Using a towel to clean the udder is statistically associated with socio-demographic characteristics ($p < 0.05$).

According to the current study, 64% of respondents consumed raw milk, and 29% consumed raw and boiled milk. This was similar to the findings of an earlier survey (Fufa *et al*., 2019), which indicated that 81.25% of respondents consumed raw milk and 18.75% boiled milk. Furthermore, Sema *et al.* (2019) discovered that 60.5% of milk consumers consumed raw milk. In contrast to Lencho and Seblewongel (2018), in Bishoftu, the majority (57.5%) consumed milk after boiling it, 23.4% used raw milk as milk, and 19.1% consumed milk after processing (yogurt), while Duguma and Geert (2015) reported that the majority (92.6%) of Jimma farmers boiled the milk before consumption, and 3.7% consumed raw milk.

In terms of disease transmission, the survey found that 50% of respondents were aware of pathogen transfer from raw milk to humans, while the remaining 50% were unaware. This finding was consistent with the study in Mersa Town, North Wollo (Oumer *et al*., 2017), where 67.5% of respondents used raw milk, as well as the study of Sema *et al*. (2019), which found that 60.5% of milk users consumed raw milk. However, this finding contradicted the findings of Lencho and Seblewongel (2018) in Bishoftu, who reported that the majority (57.5%) of milk was consumed after boiling, and Duguma and Geert (2015) in Jimma, who reported that the majority (92.6%) of farmers boiled milk before

consumption. Among socio-demographic factors, educational level was strongly associated with disease transmission by raw milk drinking ($p< 0.05$). This is due to respondents' ignorance of disease transmission through raw milk intake.

Concerning the knowledge of workers about milk-borne zoonotic diseases, only 4% of workers were aware of tuberculosis, 32% were aware of salmonellosis, 5% were aware of both TB and salmonellosis, and 8% were aware of TB, anthrax, mastitis, salmonellosis, and brucellosis. The remaining 51% were unaware of zoonotic illnesses. This revealed that participants were unaware of zoonotic diseases. The vast majority (98%) of respondents had never had a milk-borne disease, while 2% had a history of milk-borne sickness. This was similar to the findings of Lencho and Seblewongel (2018), who discovered that 91% of respondents had not had any milk-borne disease, while 9% had. However, it contradicted the findings of Oumer *et al.* (2017) in Mersa Town, North Wollo, where 44.1% and 55.9% of respondents reported suffering from milk-borne infections as a result of consuming raw milk. This discrepancy is related to the fact that the majority of people are unaware of the cause of their ailment.

Conclusions

The result indicated that a limited number of farms used individual towels, some used common towels, and others did not use any towels at all to dry their cows' udders. Furthermore, the findings showed that the majority of the farmhouses were cleaned once a day; most farms removed dung manually; raw milk consumption was also high; and awareness of milk-borne zoonotic diseases was poor. The study considered several demographic risk factors, such as gender, age, education level, and farm experiences. Those with a bachelor's degree or higher exhibited significantly greater awareness of the transmission of diseases through raw milk consumption during interviews. This was caused by a lack of knowledge, inadequate awareness-raising initiatives, and a lack of teamwork among public health players. Therefore, the following recommendations were required based on the aforesaid conclusion:

- Regular farm hygiene training and awareness should be provided to all farm personnel of all ages and educational levels.
- Cooperation should be established between human health and animal health offices.

- The milk handling procedure and farm hygiene practices should adhere to the standards.
- On dairy farms, good personal hygiene should be practiced.

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