

Food safety knowledge, attitudes, and practices among dairy wholesalers and retailers in Kandahar City, Afghanistan: a cross-sectional study

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Abstract

Food safety in Afghanistan is challenged by limited infrastructure, food insecurity, and the occurrence of pathogens such as *Staphylococcus aureus*, *Salmonella* spp., *Listeria monocytogenes*, and *Escherichia coli* O157:H7, creating potential food safety hazards that lead to health complications. These challenges pose serious threats to public health, making it necessary to implement mandatory food safety training and certification programs to improve hygiene standards among dairy wholesalers and retailers in Kandahar City. A cross-sectional study was conducted involving 250 dairy wholesalers and retailers from March to April of 2025. Data were collected through face-to-face interviews using a carefully designed, structured questionnaire. The questionnaire was divided into four sections: sociodemographic information, knowledge of food safety, attitudes, and food safety practices. Our results showed that 92% of dairy wholesalers and retailers had a high level of food safety knowledge, and 93.6% agreed that proper cleaning of equipment reduces the risk of food contamination. However, fewer than 20% of the respondents were aware of infectious diseases. The study found a significant link between household income, holding a health certificate, and the level of food safety knowledge. We recommend the implementation of specialized training programs to improve personal and environmental hygiene and ensure better compliance with food safety regulations. Therefore, it is advisable to develop a comprehensive food safety policy within the One Health framework and foster collaborative efforts to raise awareness among all stakeholders involved in food safety.

Key words: food safety, attitudes, practices, dairy, milk.

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Introduction

Foodborne diseases (FBDs) pose a significant global threat to human health, undermining healthcare systems and hindering economic development (Zahir, Ge *et al.*, 2025). The World Bank approximates that the economic repercussions of FBDs in middle- and low-income countries amount to approximately US \$95.2 billion each year (Zahir, Anis *et al.*, 2025). With an estimated incidence of over 100 million cases annually, the Eastern Mediterranean Region (EMR) is anticipated to rank as the third most impacted area by FBDs worldwide. Insufficient food handling practices and inadequate hygiene are the predominant factors contributing to these outbreaks, with more than 200 distinct diseases recognized as being transmitted through food on a global scale (Zahir, Nasim *et al.*, 2024). In low-income nations such as Afghanistan, factors such as high population density, underdeveloped infrastructure, and inadequate water, sanitation, and hygiene conditions significantly exacerbate the risks associated with food safety (Zahir, Khan *et al.*, 2024). Data from FBD reports on the

consumption of contaminated food in Afghanistan is limited; however, existing research highlights important aspects of food safety and disease prevalence. Coliform bacteria are among the most common microbial contaminants found in meat and its products (Shakhes *et al.*, 2023). A specific study in Herat province found that coliform bacteria were present in 70% and 75% of beef samples from slaughterhouses and butcheries, respectively. A detailed analysis showed that 58% of the samples that tested positive exceeded the acceptable standard levels of coliform contamination per gram. The presence of *Escherichia coli* in samples from slaughterhouses and butcheries was reported to be 52% and 72%, respectively (Shakhes *et al.*, 2023). A study in Nangarhar province found that vendor chicken livers tested positive for both *Shigella* and *Salmonella*, which contributed to diarrheal diseases being the most common foodborne illness in Afghanistan (Malik and Akhtar, 2020; Mohammad *et al.*, 2020; Faisal *et al.*, 2021). A significant number of Afghan people suffer from FBDs and microbial infections, especially those caused by Crimean-Congo hemorrhagic fever (CCHF) and lumpy skin disease. For example, research

showed that among the total CCHF cases involving butchers, their family members, and coworkers, a mortality rate of 37.9% was recorded. Many butchers (45.0%) reported blood splashing onto their faces, whereas 70.1% reported cuts on their hands from knives during work. Additionally, 27.0% of those surveyed admitted to putting knives in their mouths while dressing animal carcasses, and 27.3% of butchers ate raw liver. Hand hygiene and personal protective equipment use were acknowledged by 94.3% and 22.8% of respondents, respectively. Approximately 92% of the participants recognized CCHF, and 67.4% demonstrated a good understanding of the disease (Samadi and Safi, 2024). In Afghanistan, several national agencies play key roles in food safety by creating and enforcing regulations. The leading agencies include the Afghanistan National Standards Authority, the Ministry of Public Health, and the Ministry of Agriculture, Irrigation, and Livestock. The country's infrastructure, such as inadequate laboratories and testing equipment, along with limited healthcare access and inspection systems for food safety, hampers efforts to reduce risks, especially in dairy shops and processing sectors that are highly vulnerable to contamination. High rates of FBDs can hinder socioeconomic progress by negatively impacting healthcare, the economy, and personal productivity (Zahir and Hamdard, 2025).

The knowledge, attitudes, and practices (KAP) related to food safety among milk wholesalers and retailers are essential for guaranteeing the safety and quality of milk and dairy products. Numerous studies have evaluated KAP concerning food safety among food handlers across various contexts, including the dairy sector (Kwol *et al.*, 2020). A multitude of factors can impact the food safety KAP of milk wholesalers and retailers. A comprehensive understanding of potential hazards, including microbial contamination, chemical residues, and improper handling techniques, is critical for preserving milk safety (Rathnayake *et al.*, 2024). Research has indicated that enhanced food safety knowledge among food handlers correlates with improved food handling practices (Aytop *et al.*, 2025). Favorable attitudes towards food safety, which encompass a sense of accountability and an appreciation for the necessity of adhering to safe food handling practices, are vital for ensuring adherence to food safety regulations, such as law enforcement, to address the current food safety situation (Halim-Lim *et al.*, 2023). Consistent application of safe food handling procedures, such as proper cleaning and sanitation, temperature regulation, and prevention of cross-contamination, is imperative for reducing the risk of milk contamination (Huang *et al.*, 2019). The provision of targeted training and educational initiatives can substantially enhance food safety KAP among milk wholesalers and retailers (Zhang *et al.*, 2021). Such initiatives should focus on pertinent subjects, including hygienic milk production, hazard analysis, and the implementation of food safety management systems. The enforcement of food safety regulations and standards, including Hazard Analysis and Critical Control Points (HACCP), is pivotal in ensuring food safety within the dairy sector (Sobuj *et al.*, 2022). For instance, Law 5996, which was instituted in Turkey in 2010, implements food-handling standards for the dairy industry and mandates compliance with HACCP principles (Karaman, 2012). Socio-demographic variables, including educational attainment, professional experience, and gender, may also influence food safety KAP among food handlers (Nicolini *et al.*, 2022). Numerous scholarly investigations have evaluated KAP concerning food safety among food handlers across various contexts, including the dairy sector. In Beijing, Northern China, a cross-sectional survey involving 194 dairy plant employees analyzed their food safety knowledge, attitudes, and self-reported practices

(Kwol *et al.*, 2020). An inquiry conducted in central Kenya explored the knowledge, attitudes, and adoption of milk quality and food safety practices by smallholder dairy farmers. Focus group discussions revealed significant challenges associated with unsanitary handling practices and non-compliance with established food safety standards (Huang *et al.*, 2019). An intervention study in Ethiopia sought to enhance the KAP of female dairy farmers through tailored training programs (Zhang *et al.*, 2021).

To enhance the KAP regarding food safety among milk wholesalers and retailers, several strategic interventions should be employed. Training initiatives should specifically address identified knowledge gaps and promote positive attitudes towards food safety (Korale-Gedara *et al.*, 2023). Elevating awareness of food safety dilemmas *via* public health campaigns and educational resources can significantly bolster consumer demand for safe milk products (Mathenge *et al.*, 2017). Government bodies and regulatory agencies must formulate and enforce stringent food safety regulations and standards pertinent to the dairy industry (Karaman, 2012). Promoting the adoption of food safety management systems is crucial; the implementation of HACCP and other relevant food safety frameworks can assist milk wholesalers and retailers in detecting and mitigating potential hazards (Sobuj *et al.*, 2022). Effective collaboration among stakeholders, including farmers, processors, retailers, and regulatory entities, is vital for ensuring food safety across the entire milk supply chain (Zahir *et al.*, 2024). In several low- to middle-income nations, such as Afghanistan, a considerable proportion of milk production and distribution occurs within the informal sector, where food safety regulations may not be rigorously enforced (Karaman, 2012; Zahir and Hamdard, 2025). Smallholder dairy producers frequently lack the necessary resources and expertise to implement adequate food safety protocols (Huang *et al.*, 2019). The financial burden associated with implementing food safety measures can be a significant barrier for small enterprises (Boakye *et al.*, 2024). Cultural beliefs and practices can also substantially influence food safety behaviors (Chaudhary *et al.*, 2023). Addressing these challenges necessitates a comprehensive approach that considers the unique contexts and requirements of diverse stakeholders. To date, there is a remarkable absence of experimental research specifically investigating the factors associated with food safety awareness and practices among dairy handlers in Kandahar City. This issue is of considerable importance, given the high prevalence of FBDs reported annually among EMR residents. This study aimed to assess the factors linked to food safety knowledge and practices among dairy handlers operating in dairy shops in Kandahar City, Afghanistan. The sample size of 250 was determined across 15 zones, existing dairy shops, and feedback provided by participants.

Materials and Methods

Study sites and period

The present study was conducted in Kandahar City, Afghanistan, during March and April 2025. Kandahar City comprises 15 municipal divisions, and this research was conducted across all municipal divisions. The geographical attributes of this region predispose it to a range of devastating natural calamities (*e.g.*, floods, cyclones, and persistent drought), which have significantly impacted socio-economic conditions and exacerbated water, sanitation, and hygiene challenges (including FBDs such as diarrhea) faced by the local population in this segment of the coun-

try.

Study design, participants, and sampling

A cross-sectional study was conducted involving 250 individuals engaged in dairy handling, employed at dairy facilities within the aforementioned municipal divisions (n=15) of Kandahar City. A systematic random sampling methodology was applied to select each dairy facility, augmented by an equitable distribution of participants in instances where multiple individuals were employed at a single establishment. The research team initially collaborated with local authorities to obtain a documented catalog of dairy establishments operating in the selected districts (city corporations or municipalities). Regrettably, no official inventory was accessible; nonetheless, local authorities provided invaluable insights regarding the locations of local dairy markets, which the research team diligently documented and visited. These dairy establishments were primarily small-scale enterprises, with an average of two to three employees per facility. Eligibility for participation in the study was ascertained based on the following criteria: i) individuals directly engaged in dairy-related activities; ii) individuals possessing a minimum of 6 months of professional experience in dairy establishments; and iii) participants at least 18 years old and free from any disabilities or illnesses.

The sample size of the study was 260 participants. To address potential issues related to data omissions or incomplete responses in the survey, the research team undertook measures to recruit additional participants, resulting in a finalized sample size of 250 that was utilized in this research endeavor. A team comprising six trained research personnel, who were educated under the guidance of the principal investigator, actively engaged in the data collection process for an empirical investigation centered on dairy handlers in Kandahar City. The protocols concerning hygiene and practices in dairy handling were rigorously examined to ensure the reliability of information provided by the respondents. Interviews with the respondents were conducted during their allocated free working periods to provide them with adequate time to answer the written inquiries and diminish any potential distractions arising from their business operations. Individuals engaged in dairy shops were systematically approached randomly, and the objectives of the study were clearly articulated to them. Upon agreeing to participate in the research, the participants were asked to sign a consent form, affirming their voluntary willingness to participate in the study and their right to withdraw from participation at any time. The responses of each participant were systematically coded to ensure confidentiality. Data collection was conducted through a single face-to-face interview that utilized a questionnaire, with the questionnaires being completed either independently by the participants or with the assistance of the principal researcher or designated research assistants, depending on the literacy levels of the respondents. The estimated time required to complete each questionnaire was approximately 15-20 minutes. Importantly, ten individuals opted not to participate in the study for various reasons. Before commencing data collection, the research protocols underwent a thorough review, and ethical approval was obtained from the Department of Food Hygiene and Technology at Afghanistan National Agricultural Sciences and Technology University. The design of the questionnaires was intended to preserve respondent anonymity by ensuring the separation of personally identifiable information from publicly accessible data.

Data collection tool

The survey questions used in this investigation were derived

from antecedents established in prior scholarly work by Owiti (2023), Al-Slaihat *et al.* (2024), and Zahir, Anis *et al.* (2025), with some modifications. It was systematically divided into several segments encompassing socio-demographic information, knowledge of food safety, attitudes, and an evaluation of food safety practices. The sociodemographic segment included variables such as gender, age, occupation, years of professional experience, daily working hours, educational qualifications, employment status, household income, field of study, training in food safety protocols, and health-related certifications. A comprehensive array of 37 questions was posed to assess the wholesalers' and retailers' levels of food safety knowledge, offering five response options: true, false, do not know, yes, and no. The topics addressed within the food safety knowledge framework encompass food cross-contamination, identification of vulnerable populations susceptible to FBDs, personal and food hygiene protocols, vulnerable individuals, specific FBDs, and pathogens. To mitigate the likelihood of respondents inadvertently selecting the correct answer and to diminish randomization bias, the multiple-choice option "don't know" was included. Each response categorized as "true" was allocated one point, while the alternative responses ("false" and "do not know") received a score of zero. Consequently, the food safety knowledge scores ranged from 0 to 37, with scores of 18.5 or above categorized as indicative of a commendable level of knowledge, whereas scores below 18.5 were interpreted as reflective of a deficient level of knowledge (Chen *et al.*, 2018; Al Banna *et al.*, 2022). The second section of the questionnaire focused on the food safety practices of the respondents, accentuating elements of personal hygiene, handwashing practices, and measures taken to prevent FBDs and cross-contamination.

Validity and reliability of the questionnaire

The original English version of the questionnaire employed in this study was modified from prior academic research (Owiti, 2023; Al-Slaihat *et al.*, 2024; Zahir, Anis, *et al.*, 2025) with some modifications. However, the inquiries were later translated into Pashto during the data collection phase, as the research was conducted in regions where Pashto is predominantly used. A multilingual translator translated the text into two languages, and a separate research assistant verified the accuracy of the translation. Additionally, a secondary, independent, multilingual member of the research team conducted a back-translation of the questionnaire to ensure consistency and to minimize bias. A pilot study involving 50 dairy handlers was undertaken before the distribution of the final version of the questionnaire to confirm that all inquiries were comprehended. Notably, this study does not present the results of the piloted survey.

Statistical analysis

The data were analyzed using the Statistical Package for the Social Sciences (SPSS) software (version 23.0) (IBM, Armonk, NY, USA). Descriptive statistics, including response frequencies/percentages, means, and standard deviations, were used to summarize the variables of interest. Statistical significance was set at $p < 0.05$.

Results

The sociodemographic characteristics are systematically presented in Table 1. The study comprised 250 male participants. Nearly one-third of the respondents (29.6%) had a primary level of education. A significant proportion of the respondents (50.0%) had

professional experience ranging from 5 to 10 years; however, a minimal number of respondents had undergone food safety training (16.4%) or held health-related certifications (16.8%). The vast majority of respondents (82%) reported working for over 8 hours daily, and more than half (67.6%) were classified as permanent employees (Table 1).

Adherence to food safety knowledge among wholesalers and retailers

The evaluation of food safety knowledge about dairy products among wholesalers and retailers is presented in Table 2. A considerable majority of the respondents indicated a robust understanding of general personal hygiene and sanitary protocols within the workplace, including washing hands before work (92%), appropriately cleaning instruments (93.6%), and utilizing gloves, caps, and aprons (72.8%), as well as washing and disinfecting working surfaces and tools (78%). One-third of the respondents (30%) either lacked knowledge or provided incorrect responses regarding high-risk groups susceptible to food poisoning. Nearly half of the respondents (44 %) acknowledged that it is imperative to take leave from work during instances of infectious diseases affecting the skin and eyes. A significant proportion of respondents (68%) were unaware of the appropriate temperature required to store perishable food items. Although most participants reported good general hygiene practices, their awareness of specific pathogens was limited (Table 2).

Food safety attitude among dairy wholesalers and retailers

The evaluation of food safety attitudes among dairy retail shop personnel is presented in Table 3. A vast majority of respondents (83.2%) affirmed the critical importance of food safety in dairy

enterprises, and over half (65.2%) asserted that the provision of safe dairy products is vital for customer satisfaction. A significant number of respondents expressed their willingness (87.2%) to engage in training or guidance aimed at enhancing food safety practices, felt confident in their ability to uphold food safety within their dairy retail establishments (76%), recognized the necessity of cleaning equipment and surfaces within storage and sales areas (78.4%), adhered to stringent policies regarding chemicals used in cleaning and sterilization processes (70%), and affirmed that suppliers were periodically assessed to ascertain their food safety practices (68%). Less than half of the respondents (48%) indicated that they had implemented specific measures in response to employees exhibiting symptoms of infectious diseases (Table 3).

Compliance with food safety protocols among dairy wholesalers and retailers

The examination of adherence to food safety protocols among dairy retail shop workers is presented in Table 4. Over half of the respondents (66.80%) reported the absence of a systematic approach for labeling and dating dairy products, and a substantial majority (71.20%) had never received formal training in food safety protocols. Half of the respondents indicated that they did not inspect dairy products for signs of spoilage or contamination (50.80%) or maintain accurate temperature logs in refrigeration and storage units (50.80%). More than half (56%) acknowledged that they stored dairy products separately, followed specific procedures to avert contamination of dairy products (56.80%), and refrained from (59.20%) randomly sampling and testing for compliance with health specifications, and checked the color, taste, and aroma of the dairy products (54%) (Table 4). The results showed that household income ($p<0.001$) and employment status ($p<0.001$) were significantly associated with health certificates (Table 1).

Table 1. Socio-demographic characteristics of study participants (n=250).

Variables	Categories	Food safety training			p
		Yes	No	Total	
Age	<20	8	33	41	0.083
	21-30	26	115	141	
	31-40	7	47	54	
	>40	0	14	14	
Occupation	Wholesalers/retailers	16	55	71	0.100
	Helper	25	154	179	
Education level	No formal education	6	59	65	0.947
	Primary education	21	53	74	
	Secondary	7	56	63	
	Graduate or above	7	41	48	
Household income	<10,000	8	71	79	0.000
	10,000-15,000	15	97	112	
	15,001-20,000	11	32	43	
	20,001-25,000	7	9	16	
Work experience	<5 years	10	79	89	0.091
	5-10 years	23	102	125	
	>10 years	8	28	36	
Working hours/day	<8 hours	10	35	45	0.246
	≥8 hours	31	174	205	
Employment status	Permanent	23	146	169	0.010
	Daily	8	46	54	
	Contract	10	17	27	
Health certificate	Yes	37	5	42	0.00
	No	4	204	208	

Discussion

This investigation examined the comprehension of food safety, attitudes, and practices among milk and milk product wholesalers and retailers in Kandahar City. In conclusion, the food safety knowledge and practices of the wholesalers and retailers in this study were remarkably effective. This can be ascribed to comprehensive training, well-structured facilities for wholesalers and retailers, efficient waste management protocols, and an effective environmental management system (Zahir, Anis *et al.*, 2025). The findings revealed that a significant majority of participants possessed adequate food safety knowledge regarding dairy retail establishments. For example, over 92% of respondents compre-

hended the recommended hygienic protocols, were aware of the necessary steps to ensure the safety of dairy products, recognized the significance of pathogen transmission through dairy products, and understood that proper hand washing every 30 minutes or when warranted is crucial for food safety and minimizing contamination. Nonetheless, upon analyzing the individual components, it became apparent that the respondents exhibited superior awareness of certain food safety issues compared to others. For instance, a substantial proportion of respondents recognized that practicing hand hygiene before initiating work, utilizing protective gloves, donning caps and aprons, in conjunction with the proper sanitation of tools and cleaning and disinfection of work surfaces, reduces the risk of foodborne contamination. Numerous investigations of

Table 2. Adherence of participants working in dairy wholesalers and retailers' shops to food safety knowledge.

Statements	True		Responses False		Don't know	
	n	%	n	%	n	%
Washing hands before work reduces the risk of food contamination.	230	92.0	1	0.4	19	7.6
Using gloves while working reduces the risk of food contamination.	182	72.8	35	14.0	33	13.2
Proper use and cleaning of equipment reduces the risk of food contamination.	234	93.6	4	1.6	12	4.8
Washing and disinfecting surfaces and equipment are essential for milk safety.	195	78.0	13	5.2	42	16.8
Eating and drinking at work increases the risk of food contamination.	183	73.2	19	7.6	48	19.2
All people, including children, the elderly, and pregnant women, are equally at risk of food poisoning.	75	30.0	26	10.4	149	59.6
E.coli bacteria are a foodborne pathogen.	45	18.0	18	7.2	187	74.8
Listeria is a foodborne pathogen.	31	12.4	19	7.6	200	80.0
Diarrhea is transmitted through food.	98	39.2	45	18.0	107	42.8
Salmonella is a pathogen (microbe) from the group of foodborne pathogens (microbes).	31	12.4	25	10.0	194	77.6
Streptococcus is a pathogen (microbe) from the group of foodborne pathogens (microbes).	34	13.6	17	6.8	199	79.6
Tuberculosis is transmitted through food.	33	13.2	21	8.4	196	78.4
Jaundice is transmitted through food.	31	12.4	21	8.4	198	79.2
Brucellosis is transmitted through food.	26	10.4	23	9.2	201	80.4
Anthrax is transmitted through food.	35	14.0	15	6.0	200	80.0
During a contagious illness, such as the common cold, it is necessary to leave the workplace.	110	44.0	22	8.8	118	47.2
Cross-contamination occurs when microorganisms from contaminated food are transferred from one person to another by food handlers or equipment.	43	17.2	15	6.0	192	76.8
The correct temperature for perishable food is 5°C.	66	26.4	14	5.6	170	68.0
Do you know the proper temperature for storing dairy products to prevent bacterial growth?	127	50.8	12	4.8	111	44.4
Can you identify common pathogens associated with dairy products?	48	19.2	14	5.6	188	75.2
Are you aware of the recommended hygiene practices for handling dairy products?	84	33.6	40	16.0	126	50.4
Do you know the symptoms of foodborne illness caused by contaminated dairy products?	102	40.8	13	5.2	135	54.0
Are you familiar with the local food safety regulations and requirements for selling dairy products?	94	37.6	37	14.8	119	47.6
Do you consistently follow these regulations in your dairy retail business?	107	42.8	42	16.8	101	40.4
Have you ever faced any challenges or difficulties in complying with food safety regulations?	65	26.0	54	21.6	131	52.4
Do you know the easiest way to prevent cross-contamination?	40	16.0	25	10.0	185	74.0
Do you know what "HACCP" is related to in food safety?	37	14.8	39	15.6	174	69.6
Do you know the steps that should be taken to ensure the safety of dairy products?	86	34.4	26	10.4	138	55.2
Can bacteria in food be killed by freezing at -180 c?	27	10.8	19	7.6	204	81.6
Do most pathogens grow in the moderate pH range?	35	14.0	18	7.2	197	78.8
Are pathogenic bacteria transmitted through dairy?	45	18.0	20	8.0	185	74.0
Is washing hands properly every half hour or when necessary important for food safety and reducing contamination?	102	40.8	23	9.2	125	50.0
Is sterilization better than hand washing?	61	24.4	22	8.8	167	66.8
Can contaminated food be discovered by tasting?	116	46.4	24	9.6	110	44.0

foodborne outbreaks have identified workers' hands as the source of pathogens in implicated food vehicles. Handwashing is the most straightforward and effective method for eliminating pathogens from hands (Todd *et al.*, 2010). Consistent with findings from prior research conducted in Lebanon and Romania (Adam *et al.*, 2024; Faour-Klingbeil *et al.*, 2015; Jianu and Goleţ, 2014), nearly all participants (approximately 92%) in our study consistently washed their hands after handling waste/garbage or following visits to the restroom. Conversely, their awareness of high-risk populations vulnerable to FBDs, specific FBDs, and pathogens was significantly lower. An earlier study indicated that dairy plant workers' knowledge of specific diseases or pathogens transmitted through milk and its products was relatively inadequate (Chen *et al.*, 2018). In Amman, Jordan, over 83% of dairy retail workers were familiar with standard procedures for ensuring dairy product safety, but only 37% understood the HACCP system, indicating gaps in specific knowledge (Al-Slaihat *et al.*, 2024). In Jeddah, Saudi Arabia, food handlers exhibited moderate levels of food safety knowledge, with older participants and those with health cards showing a better understanding (Alghafari, 2024).

Regarding the perspectives of individuals employed in dairy wholesalers and retailers concerning food safety, a substantial proportion of the survey respondents exhibited a favorable disposition towards the safety measures implemented in dairy retail environments. For instance, 68% of the respondents concurred on the necessity of conducting regular assessments of production areas to ascertain their cleanliness and foster a hygienic environment conducive to the manufacture of dairy products. Furthermore, 78.40% of the respondents agreed on the critical importance of periodic evaluations of the equipment and tools utilized in the storage and preparation of dairy products to guarantee their safety. Our findings suggest that participants profited from enhanced access to educational resources and training initiatives pertaining to hygiene and food safety practices, attributed to the presence of a greater number of educational institutions and training centers within urban areas. This contrasts with the situation in other nations, where smaller dairy operations frequently encounter challenges in adhering to food safety standards due to resource constraints and a lack of adequately trained personnel (Troka *et al.*, 2025). Moreover, urban inhabitants often experience increased exposure

Table 3. Attitude of participants working in dairy wholesalers and retailers' shops towards food safety.

Statements	Responses			
	n	Yes %	n	No %
Do you think that food safety is important in the dairy business?	208	83.2	42	16.8
Do you believe that providing safe dairy products is essential for customer satisfaction?	163	65.2	87	34.8
Are you open to receiving training or guidance on improving food safety practices?	218	87.2	32	12.8
Do you feel confident in maintaining food safety standards in your establishment?	190	76.0	60	24.0
Is the cleanliness of equipment and surfaces in the storage and sale area verified?	196	78.4	54	21.6
Do you have strict policies to deal with chemicals used in cleaning and sterilization?	175	70.0	75	30.0
Are suppliers periodically evaluated to verify their food safety practices?	170	68.0	80	32.0
Are you taking specific actions to deal with employees who show symptoms of an infectious disease that can be transmitted through dairy products?	120	48.0	130	52.0
Do you think that there is a periodic inspection of the equipment and tools used in the storage and preparation of dairy products to ensure their safety?	153	61.2	97	38.8
Do you think that there is a periodic examination of production areas to ensure their cleanliness and provide a healthy environment for the manufacture of dairy products?	143	57.2	107	42.8
Should you check that the storage containers used meet health standards and maintain product quality?	170	68.0	80	32.0
Are you mandatory to check expiration dates and remove expired products from shelves?	172	68.8	78	31.2

Table 4. Compliance of participants employed in dairy wholesalers and retailers' establishments with food safety protocols.

Statements	Responses			
	n	Yes %	n	No %
Do you have a system in place for properly labeling and dating dairy products?	83	33.2	167	66.8
Have you ever received any formal training on food safety practices specific to dairy products?	72	28.8	178	71.2
Do you inspect dairy products for signs of spoilage or contamination?	123	49.2	127	50.8
Do you store dairy products in designated places separately from other products?	140	56.0	110	44.0
Do you do random samples and tests for dairy products to verify their conformity with health specifications?	102	40.8	148	59.2
Do you follow special procedures to prevent contamination of dairy products with foreign or harmful substances?	142	56.8	108	43.2
Are there special ways to deal with waste from storage and preparation processes to ensure that dairy products are not contaminated?	104	41.6	146	58.4
Do you check the stability of the color, taste, and aroma of dairy products to ensure excellence and continuous quality?	135	54.0	115	46.0
Do you keep accurate temperature records in refrigerators and storage units to ensure compliance with safety standards?	127	50.8	123	49.2

to information dissemination efforts, public health campaigns, and media attention regarding hygiene standards and regulations, resulting in heightened awareness and improved adherence to hygiene practices among urban dairy wholesalers and retailers. Additionally, urban regions typically possess enhanced infrastructure, encompassing sanitation systems, a reliable clean water supply, and waste management services, which may contribute to a more sanitary and secure working environment, thus facilitating the enforcement of hygiene protocols (WHO, 2017).

Regarding the adherence of participants engaged in dairy wholesalers and retailers' establishments to food safety protocols, our findings revealed that a minor segment, specifically 33.20%, had implemented a documented system for the accurate labeling and dating of dairy products, while a significant majority, amounting to 71.20% of participants, reported the absence of formal training on food safety practices pertinent to dairy products. Our results corroborate the assertions of Rowell *et al.* (2013), who highlighted that retail employees generally lack adequate training in hygienic handling practices. The authors further indicated that, after training, an analysis of post-training data revealed that training did not elicit a substantial improvement in store performance across the majority of the observed categories. In Jordan, only 53.6% of dairy retail workers have a documented system for labeling and providing production dates, highlighting the need for better practices (Al-Slaihat *et al.*, 2024). Additionally, according to the findings of the Health and Safety Authority (2005), proficient handling techniques are essential to ensuring the safety and quality of food products. Furthermore, Augustin *et al.* (2020) underscored that the formulation of preventive strategies aimed at mitigating the incidence of FBDs necessitates a comprehensive understanding of hygienic handling procedures throughout the stages of production, processing, and distribution. These findings underscore the need to reform training policies to evaluate and enhance the quality of training programs. Moreover, the findings indicate that within the dairy retail sector, the workforce tends to be predominantly male and frequently lacks elevated levels of formal education (Table 1). This demographic composition may result in a heightened propensity for the adoption of incorrect practices stemming from the interplay of limited formal education and the repetitive nature of the tasks commonly associated with this profession. Other studies have revealed that the risk for FBDs may result from a lack of expertise and technically trained staff (Al-Kandari *et al.*, 2019). A positive attitude towards food safety was prevalent among food handlers in Kohat, Pakistan, with 90.94% displaying an optimistic mentality (Khan *et al.*, 2022). Similarly, in Jeddah, high food safety attitudes were observed, which were significantly correlated with knowledge (Alghafari, 2024). In Kohat, Pakistan, only 47.92% of food handlers followed adequate procedures, indicating the need for improved practices (Khan *et al.*, 2022). Continuous educational and training programs are recommended to improve food safety knowledge and transform it into appropriate attitudes and practices, as observed in Jeddah (Alghafari, 2024). In Malaysia, the need for increased intervention by educational and medical institutions has been emphasized to enhance food safety (Nazmi *et al.*, 2023).

Strengths and limitations

A cross-sectional analysis investigating food safety knowledge, practices, and associated determinants among dairy wholesalers and retailers in Kandahar City, Afghanistan, exhibited both advantages and drawbacks. Such studies are instrumental in elucidating the knowledge deficiencies and practices that may precipi-

tate FBDs. Nevertheless, they encounter obstacles in data acquisition and generalizability. The foremost strength of our study is its analytical rigor and comprehensive methodological framework. Cross-sectional studies proficiently illuminate particular domains where dairy wholesalers and retailers exhibit knowledge deficiencies, including the comprehension of foodborne pathogens and safe handling procedures. They facilitate the assessment of current food safety practices among handlers and offer a temporal snapshot of adherence to safety protocols. These results can guide the development of targeted educational programs and training initiatives aimed at enhancing food safety practices. Furthermore, this study represents one of the pioneering efforts to scrutinize the factors that shape food safety knowledge and practices among meat handlers in a region characterized by a continual incidence of FBDs annually. Our findings may provide critical information for forthcoming interventions intended to improve food safety knowledge and practices.

Nonetheless, this study is not devoid of limitations that necessitate consideration when interpreting the findings. The study design captured data at a singular temporal juncture, constraining the capacity to evaluate alterations in knowledge or practices over time. Self-reported data may engender biases, as participants might exaggerate their knowledge or compliance with safety practices. For instance, food safety practices were evaluated based on self-reported data from the participants rather than through observational checklists, which may have introduced potential reporting bias. However, we employed a 5-point Likert scale for the assessment of food safety practices, which may mitigate the possibility of reporting bias. Results may lack applicability to other regions or populations due to cultural and environmental variances in food handling practices. For instance, considering the specific municipal areas of Kandahar City that were scrutinized in this study (*i.e.*, 15 municipal areas), the findings may not be generalized to represent the entire province or the nation. While cross-sectional studies yield essential insights into food safety among dairy handlers, they should be supplemented with longitudinal studies to monitor changes and advancements over time.

Conclusions

In conclusion, the cross-sectional study conducted on food safety knowledge, practices, and associated factors among dairy wholesalers and retailers in Kandahar City, Afghanistan, reveals significant adequacies in both awareness and practical application of food safety protocols. To enhance food safety knowledge and practices among dairy wholesalers and retailers in Kandahar City, it is imperative to establish specific mandatory safety regulations. These regulations ought to prioritize the improvement of education, training, and monitoring practices among dairy wholesalers and retailers to mitigate the incidence of FBDs. The implementation of obligatory food safety training for all dairy wholesalers and retailers can substantially elevate their knowledge and practices. Regulatory authorities should institute periodic hygiene inspections and certification programs for all dairy wholesalers and retailers to ensure adherence to food safety standards. Establishing routine inspections by health authorities can contribute to ensuring compliance with safety standards and identifying areas that require enhancement. The introduction of certification for dairy wholesalers and retailers who complete training can serve as an incentive for compliance with safety practices. Regular evaluations of dairy wholesalers and retailers' understanding of food safety can assist in

identifying deficiencies and customizing training programs accordingly. While these regulations are crucial, it is equally important to take into account the socio-economic factors that may impede compliance, such as low income and limited access to resources, which can impact the execution of these safety measures in Kandahar City. This study suggested good general awareness of hygiene among dairy retailers in Kandahar, but limited knowledge of pathogens and weak compliance with protocols. Mandatory training, certification, and regular inspections are urgently needed. Incorporating HACCP within a One Health framework will strengthen food safety systems and contribute to reducing FBDs. Our findings also bear significance for Kandahar City's potential to fulfill Sustainable Development Goal 2.2 by the year 2030. Ultimately, there exists an urgent requirement for intervention and longitudinal studies that encompass extensive, diverse cohorts of dairy handlers in Kandahar City to discern the factors influencing their knowledge and practices related to food safety, thereby alleviating FBDs in the region.

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