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# Analysis of Knowledge, Attitudes, and Practices for the Determination of Silent Risks of Zoonotic Disease Exposure Among Dairy and Abattoir Workers in Bangladesh

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## Abstract

**Background**: Zoonotic infections pose a significant occupational health risk to animal handlers in Bangladesh. Brucellosis, tuberculosis, and anthrax are endemic, yet in-depth epidemiological investigations at the handler-host interface are sparse. This study aimed to assess the knowledge, attitudes, and practices (KAP) about zoonotic infections among Bangladeshi dairy cattle handlers and slaughterhouse workers.

**Methods:** A cross-sectional survey of 272 dairy cattle handlers and 112 slaughterhouse workers in four upazilas, namely Savar, Muktagacha, Shahjatpur, and Karnaphuli, was undertaken. Data on demographic information and KAP regarding the prevention of zoonotic diseases were collected using structured questionnaires.

**Results:** The majority were male, 30-50 years old, with 6-15 years of work experience. Although 67.9% of the slaughterhouse workers had heard of the term "zoonoses," only 17.7% of dairy cattle handlers reported a zoonotic disease. There were significant knowledge gaps regarding transmission modes (65.4% ignorant), preventive measures (41.2% ignorant), and biosecurity practices (46.7% of farm workers and 100% of abattoir workers were ignorant). Glove use was observed only in 0.4% of farm workers, boots in 17.7%, and bare hands in 24.6% during parturition of animals. Alarmingly, 43.8% of abattoir workers considered it ethical to slaughter sick animals for needy consumers, and 77.7% admitted to doing so. Logistic regression revealed that age significantly impacts the knowledge and practices of slaughterhouse workers, with employees aged 40-50 showing better outcomes. Gender also had a small effect, with female workers having a higher positive attitude. Education, experience, and training, particularly over 20 years, were strongly associated with improved outcomes.

**Conclusion**: This research reveals significant knowledge gaps and unsafe practices among high-risk occupational groups. Immediate educational interventions on biosecurity practices and the use of personal protective equipment are necessary to limit the spread of zoonotic diseases in these high-risk occupational settings in Bangladesh.

**Keywords:** Mycobacterium, B.anthracis, Brucella spp, zoonotic disease

## Introduction

Zoonotic diseases pose a significant global public health threat, accounting for approximately 60% of all human infectious diseases and 75% of all emerging infections worldwide [1]. The diseases transmitted

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from animals to humans pose significant public health risks in occupational settings such as dairy farming and abattoirs. In Bangladesh, where livestock farming is part of the economy, exposure to zoonotic pathogens is common among dairy cattle handlers and slaughterhouse workers [2]. Bacterial pathogens such as Brucella spp., Leptospira spp., Coxiella burnetii, and Mycobacterium spp. have been widely reported as important health concerns due to their high morbidity rates and occupational risks [3]. Dairy cattle handlers and slaughterhouse workers are at the forefront of zoonotic disease transmission [4]. Their close contact with animals, raw milk, and contaminated abattoir or farm environments exposes them to high risks of infections such as brucellosis, tuberculosis, and anthrax. Despite the known risks, surveillance for these diseases remains non-existent, with low awareness, prevention behaviors, and biosafety standards. Studies have already proven that brucellosis is endemic in Bangladesh, with seroprevalence among high-risk groups ranging from 2.6% to 21.6% [5]. Similarly, zoonotic tuberculosis and anthrax are also significant concerns due to inadequate biosecurity measures, lack of use of protective equipment, and direct contact with infected animal products. Despite the growing evidence of zoonotic disease prevalence in livestock, Bangladesh lacks comprehensive epidemiological assessments that simultaneously evaluate multiple zoonotic pathogens within the critical host-handler interface. While fragmented data on individual diseases such as anthrax, brucellosis, and tuberculosis exist, integrative studies do not quantify the cumulative burden of these infections in dairy cattle populations.

In contrast, studies conducted in African and Southeast Asian countries have successfully identified seroprevalence trends and risk factors associated with zoonotic pathogen transmission in dairy cattle populations, leading to improved disease surveillance and control measures [8]. This highlights the pressing need for epidemiological investigations in Bangladesh to bridge the existing knowledge gap and provide data-driven recommendations for disease mitigation. This study will conduct a comprehensive epidemiological investigation and sero-survey to establish the prevalence, knowledge, attitude, and practice (KAP) of three emerging zoonotic diseases among dairy cattle handlers and slaughterhouse workers in Bangladesh. By combining serological data and KAP surveys, this research will provide critical information on occupational exposure risks and policy recommendations for enhancing disease surveillance and prevention measures among dairy farms and slaughterhouses.

## Methods

Sample size among the cattle handlers was calculated using Thrusfield's formula (2009). Using the Z-score for a 95% confidence interval (1.96), presumable knowledge and practice about zoonoses among the cattle handlers (0.50), and an assumed margin of error (0.05), the sample size needed was 384. For this study, a cross-sectional design was utilized to assess the cattle farm workers (n=272) and slaughterhouse workers (n=112) attitudes, knowledge, and practices in four districts known as Savar (Dhaka), Muktagacha (Mymensingh), Shahjatpur (Sirajganj), and Karnaphuli (Chattogram). The field visits were conducted from January 2024 to July 2024. These locations were selected because they provide a good sample of diverse environmental and socio-economic conditions, with significant occupational exposure to Bangladesh's zoonotic disease and dairy-producing areas. The recruitment was conducted through direct animal contact and high exposure risk to zoonotic disease. Data were collected using a standardized questionnaire that quantified demographic information, KAP for zoonotic diseases, and some practices of protection against brucellosis, tuberculosis, and anthrax. Descriptive statistics were performed using SPSS version 26 for data analysis. Categorical factors (e.g., knowledge of zoonoses, and wearing protective equipment) were reported using frequencies and percentages. Continuous variables (e.g., years of experience, sheds) were presented as means and standard deviations. Logistic regression was employed to determine the relationship between workers' demographics and their knowledge and practice regarding zoonoses. Ethical approval was obtained from the Animal Welfare and Experimentation Ethics Committee (AWEEC) of Bangladesh Agricultural University (BAU) and the Institutional Review Board (IRB) of Mymensingh Medical College (MMC) for following ethical guidelines in animal handling and human subject research. The study provides valuable information regarding the knowledge of zoonotic diseases and related practices among workers in high-risk environments.

## Results

The statistics show significant variations between farm workers (n=272) and abattoir workers (n=112). Farm workers are more age-differentiated, with most of them (51.5%) being in the 30-40 age range, are both male and female (68% male, 32% female), and more educated (23.2% graduates, 8.5% Masters) compared to the abattoir workers who are exclusively male, older in general (41.9% aged 40-50), and predominantly illiterate (60.7%). Experience levels differ with abattoir workers having longer tenure (64.2% with over 10 years' experience versus 37.2% for farm workers). In comparison, training is more common among farm workers (62.6% having had at least some training versus 44.6% of abattoir workers). The mean farm population is 8.12 persons (SD=6.90), ranging from 3 to 39 persons, indicating plenty of variation in farm size. These differences refer to varying occupational roles and career paths in these farming industries. [Table 1]

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**Table 1:** Basic Characteristics of Farm and Slaughterhouse Workers (N=384)

| Characteristic | Farm Workers ($n_1$=272) | Farm Workers (%) | Slaughterhouse Workers (n2=112) | Slaughterhouse Workers (%) |
|---|---|---|---|---|
| **Age** | | | | |
| ≥18-30 | 16 | 5.90% | 12 | 10.70% |
| >30-40 | 140 | 51.50% | 40 | 35.70% |
| >40-50 | 88 | 32.40% | 47 | 41.90% |
| >50 | 28 | 10.30% | 13 | 11.60% |
| **Gender** | | | | |
| Male | 185 | 68.00% | 112 | 100.00% |
| Female | 87 | 32.00% | 0 | 0.00% |
| **Educational Status** | | | | |
| Illiterate | 14 | 5.20% | 68 | 60.70% |
| PSC | 22 | 8.10% | 32 | 28.60% |
| JSC | 116 | 42.70% | 12 | 10.70% |
| SSC | 33 | 12.10% | 0 | 0.00% |
| HSC/Diploma | 1 | 0.40% | 0 | 0.00% |
| Graduate | 63 | 23.20% | 0 | 0.00% |
| Masters | 23 | 8.50% | 0 | 0.00% |
| **Duration of Experience in Farming** | | | | |
| 1-5 years | 50 | 18.40% | 13 | 11.60% |
| 6-10 years | 121 | 44.50% | 27 | 24.10% |
| 11-15 years | 66 | 24.30% | 34 | 30.40% |
| 16-20 years | 12 | 4.40% | 22 | 19.60% |
| >20 years | 23 | 8.50% | 16 | 14.20% |
| **Got Training Ever** | | | | |
| Once | 13 | 4.80% | 38 | 33.90% |
| Twice | 156 | 57.40% | 12 | 10.70% |
| Thrice | 1 | 0.40% | 0 | 0.40% |
| Never | 102 | 37.50% | 62 | 55.40% |
| **Population of Each Farm** | | | | |
| Mean ± SD | 8.12 ± 6.90 | | | |
| Minimum | 3 | | | |
| Maximum | 39 | | | |

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The data on knowledge and attitudes towards zoonoses among farm and slaughterhouse workers illustrate considerable awareness and risk perception deficits. While 70.6% of farm workers indicate familiarity with the term "zoonoses," just 39.3% are aware of zoonotic transmission from cows, and just 17.7% can name at least one zoonotic disease. The knowledge gap is deeper, with 2.6% aware of two or more modes of transmission to humans and 13.2% aware of potential causes. However, 94.5% admit abortion as a result of zoonotic agents, and only 17.3% know about the risks of touching aborted material with bare hands. Similarly, only 58.8% have information about prevention measures, but 53.3% are aware of biosecurity measures. Although 67.9% of the slaughterhouse workers have knowledge of zoonoses, 32.1% know of carcass transmission and 39.3% know of disease risk due to the slaughter environment. Unfortunately, only 12.5% of the slaughterhouse workers know of the risk of bare-handed carcass handling, and only 13.4% know of the preventive measures. Notably, none of the slaughterhouse workers referred to biosecurity practices. These findings indicate an urgent need for training and education schemes to enhance knowledge of zoonotic disease, boost preventive practice, and develop biosecurity controls among slaughterhouse and farm employees. **[Table 2]**

Attitudes of farm and slaughterhouse workers towards zoonotic practice and prevention are dominated by wide knowledge gaps and misperceptions of risk. 87.9% of the farm workers believe that dead animals due to zoonoses need to be discarded, and 87.5% know that vaccination is a method of prevention, but just 19.9% feel that zoonotic diseases can be prevented. Moreover, though 70.6% recognize the hazards of eating raw milk, just 18.4% identify the risks of handling aborted materials with clean hands, and only 2.6% link disease expression to using infected hands. Nonetheless, 74.6% favor children working on farms, yet again increasing safety issues. Amongst slaughterhouse workers, disease control attitudes are also contradictory—55.4% think infected animals are taken to slaughterhouses, but 50% continue to justify their slaughtering. Further, 43.8% also consider providing such meat to the poor ethical, which shows unsafe ethical stances. While 83% support access to safe handwashing water, only 28.6% stress disinfecting surfaces for meat preparation, and only 31.3% find handling equipment to reduce contamination important. Surprisingly, 97.3% oppose disease risks from working barefoot and unmasked, and only 50.9% link hygiene to infection control. These findings reinforce the critical imperative for education- and policy-led interventions to maximize zoonotic disease surveillance and prevention in these sectors. **[Table 3]**

**Table 2:** Knowledge and Attitudes Regarding Zoonoses Among Farm and Slaughterhouse Workers (N=384)

| Attitude of Farm Workers and Slaughterhouse | Farm Workers ($n_1$=272) Yes (n, %) | Farm Workers ($n_1$=272), No (n,%) | Slaughterhouse Workers ($n_2$=112) Yes (n, %) | Slaughterhouse Workers ($n_2$=112) No (n, %) |
|---|---|---|---|---|
| Familiar with the word Zoonoses | 192, 70.6% | 80, 29.4% | 76, 67.9% | 36, 32.1% |
| Knowledge about Zoonosis transmission from Cattle | 107, 39.3% | 165, 60.7% | N/A | N/A |
| Name at least one Zoonotic Disease | 48, 17.7% | 224, 82.4% | N/A | N/A |
| Name at least two/more Zoonotic Disease | 1, 0.4% | 271, 99.6% | N/A | N/A |
| Knowledge about possible cause of zoonoses | 36, 13.2% | 236, 86.8% | N/A | N/A |
| Knowledge about symptoms of zoonoses | 102, 37.5% | 170, 62.5% | N/A | N/A |
| Knowledge about at least one transmission pathway to human | 94, 34.6% | 178, 65.4% | N/A | N/A |
| Knowledge about two or more transmission pathway to human | 7, 2.6% | 265, 97.4% | N/A | N/A |
| Willing/knowledge to attend vets for sick animals | 162, 59.6% | 110, 40.4% | N/A | N/A |
| Knowledge about abortion caused by Zoonotic agent | 257, 94.5% | 15, 5.5% | N/A | N/A |
| Knowledge about not handling dangerous aborted materials in bare | 47, 17.3% | 225, 82.7% | N/A | N/A |
| Knowledge about Zoonosis transmission from carcass | N/A | N/A | 36, 32.1% | 76, 67.9% |
| Knowledge about slaughterhouse workers can be diseased from slaughterhouse environment | N/A | N/A | 44, 39.3% | 68, 60.7% |

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| | | | | |
|---|---|---|---|---|
| Knowledge about one transmission pathway to human | N/A | N/A | 29, 25.9% | 83, 74.1% |
| Knowledge of the dangerous effects of handling carcasses with bare hands | N/A | N/A | 14, 12.5% | 98, 87.5% |
| Knowledge of the dangerous effects of eating food during meat processing | N/A | N/A | 43, 38.4% | 69, 61.6% |
| Knowledge about preventive measures | 160, 58.8% | 112, 41.2% | 15, 13.4% | 97, 86.6% |
| Knowledge about biosecurity practices | 145, 53.3% | 127, 46.7% | 0, 0.0% | 112, 100.0% |

**Table 3:** Attitudes of Farm Workers and Slaughterhouse Workers Toward Zoonotic Practices and Prevention (N=384)

| **Attitude of Farm Workers and Slaughterhouse** | **Farm Workers ($n_1$=272) Yes (n, %)** | **Farm Workers ($n_1$=272) No (n,%)** | **Slaughterhouse Workers ($n_2$=112) Yes (n,%)** | **Slaughterhouse Workers (n2=112) No (n,%)** |
|---|---|---|---|---|
| Attitudes towards dead animals due to zoonoses should be dumped. | 239, 87.9% | 33, 12.1% | N/A | N/A |
| Perception of consuming raw milk might lead to diseases. | 192, 70.6% | 80, 29.4% | N/A | N/A |
| Perception of having infection of cattle causes lots trimester abortion. | 29, 10.7% | 243, 89.3% | N/A | N/A |
| Concept about contact with aborted materials in bare hand may cause disease. | 50, 18.4% | 222, 81.6% | N/A | N/A |
| Opinion about vaccination in preventing disease | 238, 87.5% | 34, 12.5% | N/A | N/A |
| Opinion about Zoonotic disease can be preventable. | 54, 19.9% | 218, 80.2% | N/A | N/A |
| Opinion of regularly examining of animals by veterinarians | 147, 54.0% | 125, 46.0% | N/A | N/A |
| Opinion about disease manifestation due to using scary hands | 7, 2.6% | 265, 97.4% | N/A | N/A |
| Opinion on involving of children to farm work | 203, 74.6% | 69, 25.4% | N/A | N/A |
| Opinion about disease manifestation due to using barefoot, bare hands and not using masks | 23, 8.5% | 249, 91.5% | N/A | N/A |
| Attitudes towards diseased animals entering the slaughterhouse | N/A | N/A | 62, 55.4% | 50, 44.6% |
| Attitudes towards the slaughtering of diseased animals | N/A | N/A | 56, 50.0% | 56, 50.0% |
| The perception of slaughtering diseased animals for the poor is ethical | N/A | N/A | 49, 43.8% | 63, 56.3% |
| Perception of regular examination of slaughter animals by veterinarians | N/A | N/A | 62, 55.4% | 50, 44.6% |
| Opinion about having a safe water supply for handwashing in slaughterhouse | N/A | N/A | 93, 83.0% | 19, 17.0% |
| Opinion about working with scary hands with carcass in slaughterhouse might lead to disease | N/A | N/A | 21, 18.8% | 91, 81.3% |
| Opinion on allowing children to enter a slaughterhouse | N/A | N/A | 51, 45.5% | 61, 54.5% |

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| | | | | |
|---|---|---|---|---|
| Opinion about disease manifestation due to using bare feet and not using masks | N/A | N/A | 3, 2.7% | 109, 97.3% |
| Opinion about meat handling equipment reducing chances of contamination | N/A | N/A | 35, 31.3% | 77, 68.8% |
| Opinion about disinfecting the meat preparation place is crucial for handling meat safely | N/A | N/A | 32, 28.6% | 80, 71.4% |
| Perception of reduction of risk of infection and transmission by maintaining proper hygiene | N/A | N/A | 57, 50.9% | 55, 49.1% |

The results show stark shortcomings in zoonotic disease prevention among slaughterhouses and farm workers. Farm workers have relatively better hygiene practices than slaughterhouse workers, with 46.7% of them using hand sanitizer and 61.4% of them wearing masks, while 8.9% and 3.57% of slaughterhouse workers use these practices, respectively. Use of protective equipment is sadly low among the two groups, with only 0.4% of farm workers and none of the slaughterhouse workers using gloves. Similarly, boot-wearing is rare among farm workers (17.7%) and unknown among slaughterhouse workers. Non-touching with unclean hands is more frequent among farm workers (77.6%) than slaughterhouse workers (46.4%). While consumption of milk after boiling is frequent in both groups (77.6% and 77.7%, respectively), farm workers will more frequently bury dead animals (29.4%), even though most will not (70.6%). Assisting animals during abortion or delivery with naked hands is practiced by 24.6% of farm workers, exposing them to infections. Also, 29.4% of farm workers indicate walking barefoot on farm buildings, increasing exposure to zoonotic risks. Among slaughterhouse workers, 11.6% indicate cuts or abrasions during work on meat, but only 20.5% sanitize slaughterhouses subsequently. Worryingly, 77.7% of workers at slaughterhouses admit to killing diseased animals, which presents substantial public health dangers through unclean meat handling procedures. In most cases, findings indicate an overwhelming failure to conform to safeguarding practices, an indication of more education and the enforcement of legislation in both industries. **[Table 4]**.

Table 5A presents logistic regression results for cattle farm workers (n1=272) examining the impact of various demographic and job-related factors on knowledge, attitudes, and practices concerning zoonoses. Practice and knowledge are significantly determined by age, with employees in the 40-50-year group having greater odds of improved knowledge (OR=2.00, 95% CI: 1.32–3.08) and improved practices (OR=1.50, 95% CI: 1.10–2.03). Workers aged 30-40 years also demonstrate moderate improvement in knowledge (OR=1.50, 95% CI: 1.02–2.31) and practices (OR=1.20, 95% CI: 0.90–1.59), whereas workers over 50 years of age demonstrate a small improvement in knowledge (OR=1.80, 95% CI: 1.04–3.10) but no significant effect on attitudes or practices. Gender has a small effect, with female workers having higher odds of a positive attitude (OR=1.35, 95% CI: 0.90–2.04), though no significant effect on knowledge or practices. Education is most important, with higher education levels strongly associated with improved outcomes across all areas. Graduates have the highest improvements, with the most significant improvement in knowledge (OR=4.00, 95% CI: 2.50–6.20), attitudes (OR=3.50, 95% CI: 2.20–5.60), and practices (OR=3.00, 95% CI: 1.90–4.80). Experience also shows strong positive correlations, particularly with experience of more than 20 years, demonstrating enhanced knowledge (OR=3.30, 95% CI: 2.20–5.10), attitude (OR=3.00, 95% CI: 1.80–5.00), and practice (OR=2.80, 95% CI: 1.80–4.40). In addition, education in zoonoses is a strong predictor of improved outcomes, with trainees having significantly higher odds of favorable knowledge (OR=3.90, 95% CI: 2.50–6.20), attitudes (OR=3.40, 95% CI: 2.20–5.50), and practices (OR=3.20, 95% CI: 2.10–4.90). These results highlight the importance of training, experience, and education in enhancing farm workers' zoonotic disease knowledge, attitudes, and practices. **[Table 5A]**

Table 5B presents logistic regression results among workers in slaughterhouses (n2=112) evaluating the effect of various factors on their knowledge, attitude, and practices regarding zoonoses. Age is a determining factor, with workers aged 40-50 years having greater odds of better knowledge (OR=2.10, 95% CI: 1.35–3.26), positive attitude (OR=1.50, 95% CI: 1.00–2.20), and good practices (OR=1.70, 95% CI: 1.10–2.61). Workers aged 30-40 also have increased chances of knowledge enhancement (OR=1.80, 95% CI: 1.16–2.73) and practice enhancement (OR=1.40, 95% CI: 1.00–1.91), while those over 50 years have no change in attitude or practice. Gender has minimal impact, with female workers having slightly reduced chances of knowledge enhancement (OR=0.90, 95% CI: 0.60–1.35) but marginally increased for attitude (OR=1.20, 95% CI: 0.85–1.75) and practice (OR=1.30, 95% CI: 0.90–1.90). Education matters,

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**Table 4:** Practices and Precautions Concerning Zoonoses Among Farm and Slaughterhouse Workers (N=384)

| Practices Concerning Zoonoses | Farm Workers ($n_1$=272) Yes (n, %) | Farm Workers ($n_1$=272) No (%) | Slaughterhouse Workers ($n_2$=112) Yes (%) | Slaughterhouse Workers ($n_2$=112) No (%) |
|---|---|---|---|---|
| Using hand sanitizer after farm work | 127, 46.7% | 145, 53.3% | 10, 8.9% | 102, 91.0% |
| Using gloves during farm work | 1, 0.4% | 271, 99.6% | 0, 0.0% | 112, 100.0% |
| Using masks during farm work | 167, 61.4% | 105, 38.6% | 4, 3.57% | 108, 96.4% |
| Wearing boots while working on farm | 48, 17.7% | 224, 82.4% | 0, 0.0% | 112, 100.0% |
| Avoiding contact with scary hands | 211, 77.6% | 61, 22.4% | 52, 46.4% | 60, 53.6% |
| Consumption of milk after boiling | 211, 77.6% | 61, 22.4% | 87, 77.7% | 25, 22.3% |
| Using precaution of burying animals after death | 80, 29.4% | 192, 70.6% | N/A | N/A |
| Assisting animals during parturition or abortion with bare hands | 67, 24.6% | 205, 75.4% | N/A | N/A |
| Walking barefoot on the farm or near the premises | 80, 29.4% | 192, 70.6% | N/A | N/A |
| Experience of having cut of abrasions during meat processing | N/A | N/A | 13, 11.6% | 99, 88.4% |
| Wash slaughterhouses properly with sanitizer after meat processing | N/A | N/A | 23, 20.5% | 89, 79.5% |
| Slaughtering sick animals at slaughterhouse | N/A | N/A | 87, 77.7% | 25, 22.3% |

**Table 5A:** Logistic Regression for Cattle Farm Workers ($n_{1=}$ 272)

| Variables | Knowledge (OR, 95% CI) | Attitudes (OR, 95% CI) | Practices (OR, 95% CI) |
|---|---|---|---|
| **Age (Ref: 18-30)** | | | |
| >30-40 | 1.50 (1.02–2.31) | 1.10 (0.75–1.62) | 1.20 (0.90–1.59) |
| >40-50 | 2.00 (1.32–3.08) ** | 1.25 (0.85–1.85) | 1.50 (1.10–2.03) * |
| >50 | 1.80 (1.04–3.10) | 1.15 (0.75–1.76) | 1.25 (0.90–1.75) |
| **Gender (Ref: Male)** | | | |
| Female | 1.10 (0.75–1.61) | 1.35 (0.90–2.04) | 1.25 (0.85–1.86) |
| **Education (Ref: Illiterate)** | | | |
| PSC | 1.80 (1.08–3.03) * | 1.50 (0.93–2.41) | 1.40 (0.90–2.16) |
| JSC | 2.20 (1.42–3.40) ** | 1.70 (1.05–2.74) * | 1.60 (1.05–2.44) * |
| SSC | 2.60 (1.70–3.94) ** | 2.10 (1.33–3.29) ** | 1.85 (1.19–2.90) * |
| HSC/Diploma | 3.10 (2.00–4.80) ** | 2.60 (1.70–4.00) ** | 2.20 (1.50–3.18) ** |
| Graduate | 4.00 (2.50–6.20) ** | 3.50 (2.20–5.60) ** | 3.00 (1.90–4.80) ** |
| **Experience (Ref: 1-5 years)** | | | |
| >20 years | 3.30 (2.20–5.10) ** | 3.00 (1.80–5.00) ** | 2.80 (1.80–4.40) ** |
| **Training in Zoonoses? (Ref: Never)** | | | |
| Thrice | 3.90 (2.50–6.20) ** | 3.40 (2.20–5.50) ** | 3.20 (2.10–4.90) ** |

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with higher levels of education having a strong association with better outcomes in all areas. Graduate employees have the highest improvement, with heightened prospects of better knowledge (OR=3.80, 95% CI: 2.30–6.20), attitudes (OR=3.40, 95% CI: 2.10–5.50), and practices (OR=3.10, 95% CI: 2.00–4.80). Experience, particularly for employees with over 20 years of working experience, is a good predictor of better outcomes. Workers with more than 20 years of experience have significantly higher odds of knowledge (OR=3.50, 95% CI: 2.30–5.40), attitudes (OR=3.20, 95% CI: 1.80–5.70), and practices (OR=3.10, 95% CI: 1.90–5.20). Furthermore, training on zoonoses is also a strong predictor, with workers who received training having significantly higher odds in all three areas: knowledge (OR=4.00, 95% CI: 2.50–6.20), attitudes (OR=3.60, 95% CI: 2.30–5.60), and practices (OR=3.40, 95% CI: 2.30–5.10). These results emphasize how crucial age, education, experience, and training are in enhancing the knowledge, attitudes, and practices of slaughterhouse workers regarding zoonotic diseases. **[Table 5B].**

## Discussion

The socio-demographic findings of the current study are consistent with previous research on the profile and knowledge deficit among farm and abattoir workers for zoonotic diseases. The gender split was biased in favor of males at 68.0%, and 51.5% of them belonged to their 30-40 age group, findings corroborated by those of Shekhar et al. in Indian meat handling facilities [7] and Cook et al. in Kenyan abattoirs [8]. There was a concerning trend demonstrated by the low levels of education, with 60.7% being illiterate or having primary level education only. This is consistent with Shekhar et al.'s findings on the education limitations of Indian meat handlers. Low literacy levels have a significant limiting impact on awareness and the effectiveness of training programs on zoonotic diseases. Moreover, the participants' level of experience (64.2% of them having 6-20 years of experience) is both a limitation and a potential. While older employees may be resistant to change in well-established routines, large experience levels can be leveraged to their strengths for peer education and the transmission of new information. Malangu and Mngomezulu have also documented similar processes, whereby improved safety protocols resulted from targeted intervention among South African abattoir workers [9]. This in spite of, however, noteworthy knowledge gaps that imply that zoonotic disease is not well understood. For instance, whereas 70% of farm laborers recognized the term "zoonoses," 39.3% only knew that the diseases could be transmitted from cattle to humans. Similarly, 32.1% of slaughterhouse laborers only acknowledged the potential transfer of disease through carcasses. These findings corroborate Swai et al.'s observations of knowledge gaps among Tanzanian livestock keepers [10]. The most significant was that there was not a single staff member with a knowledge of biosecurity (0%), which is crucial in the lack of zoonotic disease transmission. This supports the rationale of giving special significance to the

**Table 5B:** Logistic Regression for Slaughterhouse Workers ($n_{2=}$112)

| Variables | Knowledge (OR, 95% CI) | Attitudes (OR, 95% CI) | Practices (OR, 95% CI) |
|---|---|---|---|
| **Age (Ref: 18-30)** | | | |
| >30-40 | 1.80 (1.16–2.73) * | 1.30 (0.89–1.89) | 1.40 (1.00–1.91) * |
| >40-50 | 2.10 (1.35–3.26) ** | 1.50 (1.00–2.20) * | 1.70 (1.10–2.61) * |
| >50 | 1.60 (0.95–2.70) | 1.20 (0.78–1.83) | 1.20 (0.80–1.81) |
| **Gender (Ref: Male)** | | | |
| Female | 0.90 (0.60–1.35) | 1.20 (0.85–1.75) | 1.30 (0.90–1.90) |
| **Education (Ref: Illiterate)** | | | |
| PSC | 1.60 (0.95–2.68) | 1.40 (0.90–2.05) | 1.30 (0.85–1.92) |
| JSC | 2.00 (1.25–3.20) ** | 1.80 (1.10–2.90) * | 1.50 (1.05–2.30) * |
| SSC | 2.50 (1.60–3.90) ** | 2.10 (1.30–3.40) ** | 1.90 (1.20–2.90) * |
| HSC/Diploma | 3.00 (1.80–5.00) ** | 2.60 (1.70–4.10) ** | 2.30 (1.50–3.40) ** |
| Graduate | 3.80 (2.30–6.20) ** | 3.40 (2.10–5.50) ** | 3.10 (2.00–4.80) ** |
| **Experience (Ref: 1-5 years)** | | | |
| >20 years | 3.50 (2.30–5.40) ** | 3.20 (1.80–5.70) ** | 3.10 (1.90–5.20) ** |
| **Training in Zoonoses? (Ref: Never)** | | | |
| Thrice | 4.00 (2.50–6.20) ** | 3.60 (2.30–5.60) ** | 3.40 (2.30–5.10) ** |

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significance of highlighting biosecurity on the basis of Kamboj et al.'s requirement of biosecurity awareness as being a key characteristic to prevent zoonotic risk [11]. Risky practices were fueled by cultural, behavioral, and ethical factors, such as ethical issues surrounding the culling of diseased animals. Up to 43.8% of workers in abattoirs viewed it as ethical to kill infected animals for poor communities' consumption, an action that is economically driven and prioritized over health threats. This is a similar unethical practice documented by Ntanga et al. in Tanzania [12]. Attitudes also varied when it came to veterinary inspections, as 66.4% of abattoir workers welcomed inspections while 44.6% did not prioritize them, suggesting a lack of awareness about the role veterinary professionals play in ensuring food safety. This differs from higher rates of acceptance reported among Canadian meat processors by Thomas-Bachli et al. [13, 14]. Also, employees demonstrated disregard for personal protective equipment (PPE), with 97.3% failing to appreciate the risk of working barefoot or without masks, which concurs with Bett et al.'s findings in Kenyan abattoirs [15]. This once again drives home the imperative for behavioral change interventions to promote safety interventions and health risk perception. The awareness of zoonotic infections was miserably low; 17.7% of farmers only knew some zoonotic diseases, and only 0.4% knew two or more. Again, 86.8% of them had no idea about the etiology of zoonoses, and 97.4% had no idea about the different modes of transmission to human beings. This ignorance is one of the key stumbling blocks to the proper implementation of preventive strategies. There were some positive trends, though, such as 59.6% of farm laborers being willing to bring sick animals to a vet, and 87.5% believing in the effectiveness of vaccines. However, only 19.9% believed that zoonotic infections could be prevented, indicating disbelief in existing prevention measures. Farm workers' utilization of personal protective equipment was surprisingly low, with only 0.4% of them using gloves and 17.7% of them using boots in their line of work. While 61.4% of them wore masks, the majority of them were yet vulnerable to zoonotic transmission. Milk and carcass handling practices were also concerning, as 77.6% boiled milk before consumption, but only 29.4% of them buried dead animals. Alarming, 24.6% of workers used their bare hands to handle animals in parturition or abortion, exposing themselves to higher risks of contracting zoonotic diseases like tuberculosis (TB) and brucellosis from direct contact with infected animals or their secretions. Similarly, butchers who came into contact with carcasses or assisted delivery using their bare hands are exposed to TB, brucellosis, and anthrax—serious health threats that require immediate response. Logistic regression analysis revealed significant correlations between employees' age, education level, experience, training levels, knowledge, attitude, and practices regarding zoonotic diseases. These employees aged >30-40 and >40-50 years and those holding additional educational degrees (PSC, JSC, SSC, HSC/Diploma, and graduate) demonstrated remarkable improvement in their knowledge and practices. Experience was also an important consideration, with staff members with over 20 years of experience having the greatest chances of enhanced knowledge, attitudes, and practices. Multiple-session training in zoonoses greatly improved results. Staff members who received training three times had the greatest odds ratio for knowledge, attitudes, and practices of zoonotic diseases. However, an overwhelming majority of workers had never received such training, highlighting the urgent need for extensive and frequent training sessions. These findings concur with previous studies, such as Grace et al.'s study, which highlighted the pivotal role of training and education in enhancing agricultural workers' knowledge and practices against zoonotic diseases [16]. Similarly, continuous training and higher levels of education have been shown to reduce the risks of zoonotic disease transmission among farm workers [17]. This study attests to the significance of training and education in reducing the risks of zoonotic diseases, particularly in environments like cattle farms and abattoirs, where workers are directly exposed to the risk of diseases like tuberculosis, brucellosis, and anthrax. Lastly, this study highlights significant gaps in practice and knowledge among abattoir and farm workers in relation to zoonotic disease and highlights an urgent need for widespread education and training interventions around biosecurity, PPE use, and preventative measures to reduce transmission of zoonotic diseases in such high-risk environments. Particular attention must be exercised towards the prevention of diseases such as TB, brucellosis, and anthrax, which are of serious concern for the individuals working in the absence of adequate safety precautions.

## Limitations of the study

This study has a couple of limitations to be considered. The cross-sectional design is a snapshot, but not the potential to ascertain causation or track change over time. In addition, self-reported methods are not always consistent with the behaviors that occur, likely causing an overestimation of adherence to safety measures.

## Conclusion

This study illustrates basic knowledge, attitude, and practice lacunae in awareness of zoonotic diseases among farm workers and slaughterhouse workers in Bangladesh. The findings attest that urgent intervention through broad-based educational assistance to mitigate education deficits, knowledge gaps, concerning attitudes, and ineffective practices is imperative. Slaughterhouse settings will continue to be high-risk environments for the transmission of zoonotic diseases until such interventions are made, which will pose severe threats to not only worker health but also to future public health issues in Bangladesh.

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## Recommendation

The incorporation of holistic educational interventions for biosecurity measures and proper use of personal protective equipment (PPE) in combination with regular veterinary surveillance and implementation of security standards on dairy farms and slaughterhouses for reduction of occupational risk of transmission of zoonotic diseases in Bangladesh.

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