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Critical Gaps in Zoonotic Disease Knowledge and Biosecurity Practices Among Commercial Poultry Farmers in Northern Bangladesh: A Cross-Sectional Study

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Abstract

Zoonotic diseases can threaten public health, particularly in areas where humans and animals interact closely. This study aimed to evaluate poultry farmers' awareness of zoonotic poultry diseases, their hygiene practices, and the factors influencing their knowledge in northern Bangladesh. A total of 125 poultry farmers were interviewed to learn about their knowledge, attitudes, and practices regarding common poultry diseases and zoonotic risks. The results revealed high awareness of diseases like Newcastle and avian influenza, but limited knowledge of zoonotic diseases such as salmonellosis. Basic hygiene practices, including avoiding eating sick birds and burying dead birds, were widely adopted, but the use of personal protective equipment (PPE) was quite low. Only 26.4% of respondents used face masks, and less than 25% used gloves or waterproof boots. Multivariable analysis identified higher education, younger age (≤45 years), and farming experience (≤5 years) as significant predictors of better knowledge of zoonotic risks. The findings highlighted the importance of targeted interventions to help them learn more, promote the use of PPE, and enhance overall biosecurity. The study highlights the need for training programs that address the specific demographics of poultry farmers in Bangladesh. Targeted interventions are essential to control zoonotic disease transmission and enhance public health outcomes in intensive poultry farming regions.

Introduction

Poultry farming is a cornerstone of Bangladesh's agricultural economy, not only serving as a vital source of protein but also sustaining millions of livelihoods. The sector's recent, considerable expansion has played a crucial role in boosting national food security and creating widespread employment opportunities in rural areas (Das *et al.*, 2008). Nevertheless, this expansion brings with it a heightened risk of poultry diseases and associated zoonotic threats, which can adversely impact both poultry production and public health.

Common poultry diseases such as Newcastle disease, avian influenza, and infectious bursal disease are prevalent in Bangladesh, frequently resulting in economic losses due to higher mortality rates and reduced productivity (Uddin *et al.*, 2025; Bhuiyan *et al.*, 2019a). This study indicates that a significant majority of farmers (92%) recognize Newcastle disease as a primary concern, with avian influenza following closely at 84% (Kwon *et al.*, 2020; Ali *et al.*, 2021a). Even with this awareness, poultry farmers continue to struggle with a lack of clarity or understanding regarding zoonotic diseases that can be transmitted from poultry to humans (Ali *et al.*, 2019).

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Zoonotic diseases like avian influenza, salmonellosis, and colibacillosis pose significant risks, particularly in rural areas where interactions between farmers and poultry are frequent (Nga *et al.*, 2019; Nooruzzaman *et al.*, 2025).

The situation in Bangladesh exacerbates these challenges. The majority of poultry farms tend to be small to medium-sized, frequently facing challenges such as limited access to veterinary services, insufficient understanding of biosecurity protocols, and restricted utilization of personal protective equipment (PPE). Although educated farmers follow to fundamental hygiene practices, such as disposing of dead birds and sanitizing their hands, this study reveals that the use of PPE, such as face masks (26.4%) and hand gloves (22.4%), is notably insufficient. The absence of safety measures increases the risk of exposure to zoonotic pathogens, endangering the health of both farmers and their surrounding communities (Odo *et al.*, 2015; Bhuiyan *et al.*, 2019b).

Although current research has thoroughly defined the epidemiology of poultry diseases in Bangladesh, a significant gap remains concerning the human aspect of disease management: the knowledge, attitudes, and practices (KAP) of the farmers. Contemporary literature indicates that awareness is diverse; nevertheless, there is lacking detailed evidence regarding how particular socio-demographic factors—such as formal education, farming experience, and age—influence a farmer's acceptance of protective measures (Ayim-Akonor *et al.*, 2020; Ali *et al.*, 2022). This study aims to address this gap by shifting from broad epidemiological trends to a targeted assessment of poultry producers in Northern Bangladesh. Our objective was to evaluate poultry farmers' awareness, hygiene practices, and factors influencing their knowledge of common and zoonotic poultry diseases in northern Bangladesh. This research presents an evidence-based foundation for improving biosecurity precautions and reducing the public health risk of zoonotic transmission in the region.

Materials and Methods

Study design

For this study, a cross-sectional study design was adopted. As a study type, cross-sectional studies allow for the measurement or evaluation of health outcomes and determinants of health in populations and their features (Wang and Cheng, 2020).

Study area and population

The study was conducted in 2023 in the Bogura Sadar of northern Bangladesh (coordinates: 24°51′N 89°22′E) (Figure 1), an area known for its significant poultry production with 664 commercial poultry farms. This makes it a perfect spot to explore the awareness of poultry diseases and the practices of local farmers. The poultry industry here plays a crucial role in the local economy, with a mix of small and medium-sized farms scattered throughout the region.

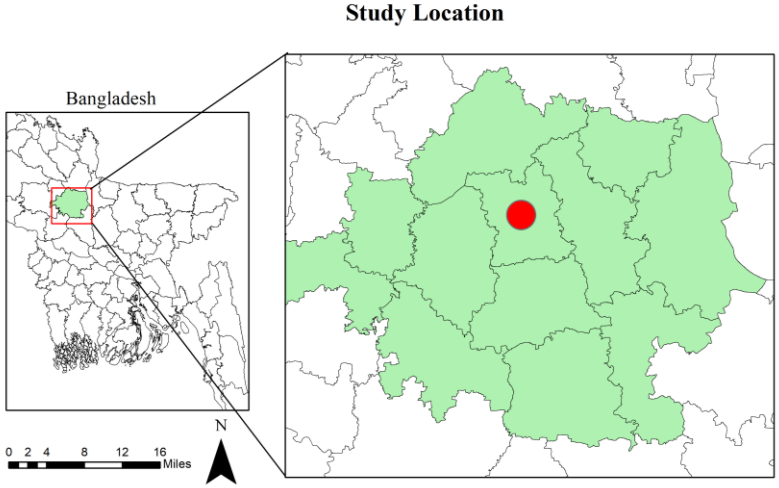


Figure 1. The study location is highlighted on the map as red circle (Bogura Sadar under Bogura district) of Bangladesh. The map was created by ArcGIS v10.8.

Farm selection

The poultry farms were selected according to their registration with the local farmers' association. The association members were initially reached out to through phone calls and in person. Farmers were interviewed after explaining the objective of the study and their consent was taken prior to conducting the interviews. To promote widespread engagement, the ideal respondents were filtered again by recommendation of the members of the association

and these members were requested to participate in the study using a snowball sampling method. The interviews took place exclusively on farms where the birds were present and at least one farmer on available during the time of visit.

Questionnaire design

The farmers were interviewed with a standardized and validated questionnaire consists of both open and close ended questions. The use of both close and opened questionnaire was to ensure that the sociodemographic and knowledge, attitude and practices of the farmers were captured (Desai and Reimers, 2019). A multi-stage validation method was employed to ensure its scientific rigor and cultural appropriateness. The data was initially developed according to existing biosecurity guidelines and subsequently evaluated by a team of veterinarians to ensure technical accuracy and relevance to the regional disease profile. The questionnaire was translated into the native language (Bangla), to overcome linguistic difficulties. Face validity was then confirmed via a pilot study with a representative cohort of poultry farmers from a nearby district, facilitating the translation of technical terminology into easily understood local language, thereby ensuring comprehensibility for participants with diverse literacy levels. The comprehensive systematic tool addressed essential areas such as farming practices, stringent biosecurity measures, and increased awareness of zoonotic transmission, providing a solid foundation for the collection of dependable data on health risks to the public in northern Bangladesh.

Statistical analysis

Data analysis applied descriptive and inferential statistics. We analyzed the demographic data, disease awareness, and hygiene practices using frequencies and percentages. Chi-square tests demonstrated correlations between demographic variables and awareness of zoonotic diseases. Additionally, multivariable logistic regression models were used to determine crude and adjusted risk ratios (RR and aRR) with 95% confidence intervals (CIs) to identify predictors of knowledge and preventative measures. The final models have been adjusted for sex, age, education, and farming experience. Descriptive statistics encompassed the entire cohort (n = 125), whereas the multivariable analysis was confined to a subset of 80 respondents who contributed complete data across all knowledge domains and met the criteria for binary classification; cases with incomplete responses or ambiguous scores were omitted to keep the statistical power and reliability of the regression model. All analyses were conducted using R software (version 4.5.2), with significance set at $p < 0.05$.

Results

Demographic characteristics of respondents

A total of 125 poultry farmers participated in the study (Figure 2). Most respondents were male (81.6%), and over 60% were aged between 45 and 64 years. Educational attainment varied, with 51.2% having completed secondary school (SSC) and 20% completing higher secondary (HSC), while 8.8% reported no formal education. Regarding experience, 57.6% had 1–5 years of farming involvement, and 23.2% had more than five years. These demographic patterns are important for understanding the baseline knowledge, attitudes, and practices toward zoonotic disease risks and inform targeted public health interventions in the region.

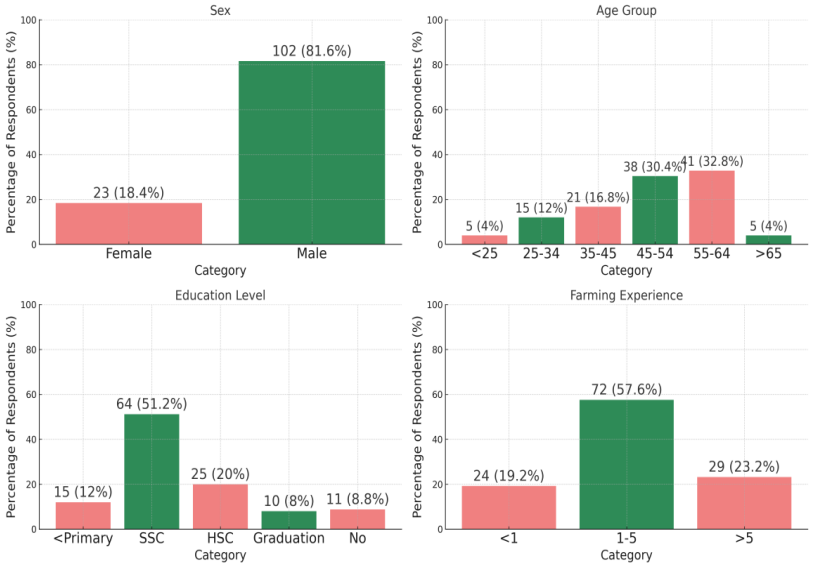


Figure 2. Demographic characteristics of poultry farmers (n = 125), displayed by sex, age group, education level, and farming experience. Bars show the number and percentage of respondents in each category.

Knowledge of poultry diseases

The range of poultry diseases recognized by farmers was illustrated in Figure 3. Awareness was highest for viral diseases such as Newcastle disease (92%) and avian influenza (84%), followed by infectious bursal disease (72.8%). Among bacterial diseases, colibacillosis (67.2%) and necrotic enteritis (63.2%) were more commonly mentioned than CRD/mycoplasmosis (44%) or salmonellosis (40.8%). Knowledge of coccidiosis, a protozoal disease, was reported by 48.8% of respondents. However, awareness of fungal diseases such as aspergillosis (15.2%) and viral Marek's disease (20.8%) remained low. These findings indicate that farmers are more familiar with major viral poultry diseases, likely due to public health campaigns and visible mortality patterns. Conversely, awareness of zoonotic bacterial and fungal diseases remains limited, underscoring the need for targeted training programs to improve recognition and reporting of less visible or emerging threats in poultry health.

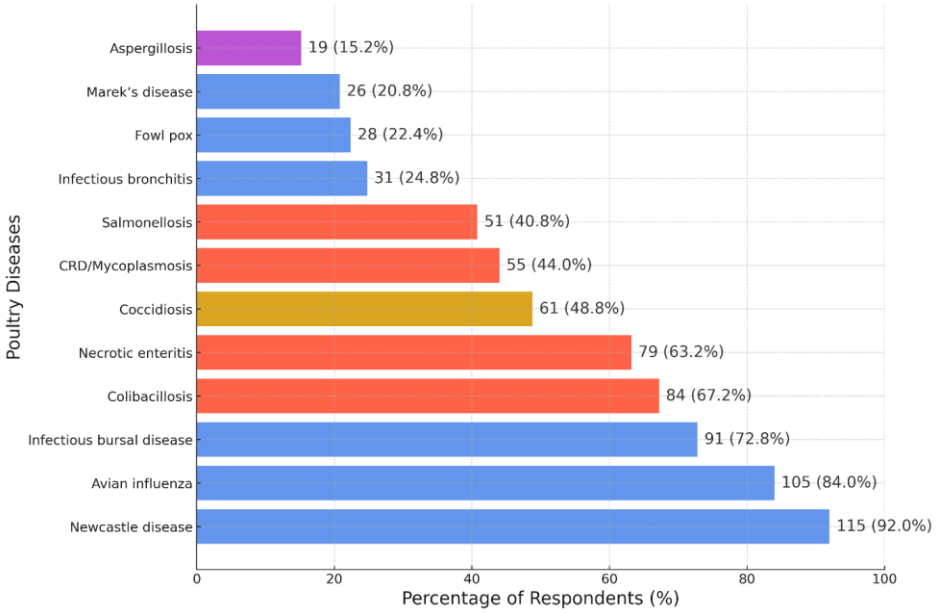


Figure 3. Poultry disease awareness among farmers in the Bogura district, Bangladesh (n = 125), categorized by disease type: viral diseases (blue), bacterial diseases (red), fungal disease (purple), and protozoal disease (gold). Bars are sorted in ascending order based on percentage of respondents who named each disease. Labels show both number and percentage of responses.

Personal protective equipment usage and hygiene practices

As shown in Figure 4, the majority of respondents reported consistent adoption of basic hygiene practices. Nearly all farmers avoid eating sick birds (96.8%), burying dead birds (88.0%), and treating sick birds when sick (87.2%). A substantial proportion also reported washing hands (68.8%) and clothing (50.4%) after handling poultry. However, the usage of personal protective equipment (PPE) was considerably lower. Only 26.4% used face masks, 23.2% wore waterproof boots, and 22.4% reported using hand gloves during poultry handling. The use of aprons (12%), disinfectant footbaths (21.6%), or protective eye and head gear (under 6%) was minimal. These findings highlight a difference between basic hygiene awareness and implementation of full biosecurity protocols, suggesting the need for specific efforts that promote not only knowledge but also access to and regular use of PPE among poultry farmers.

Awareness and self-protection from zoonotic poultry diseases

Figure 5 and Figure 6 illustrate the relationships between demographic characteristics and knowledge of poultry diseases, including zoonotic risks. The clustered bar chart (Figure 5) shows that awareness was substantially higher among farmers with higher education (97.1%) than those with lower education (62.2%). Farmers with more than five years of experience demonstrated greater knowledge (86.2%) compared to those with less experience (67.7%). Younger farmers (≤45 years) were also more knowledgeable (85.4%) than older ones (>45 years, 65.5%). No significant difference was observed between males and females. The dual forest plot (Figure 6) presents both crude and adjusted risk ratios (RR and aRR) with 95% confidence intervals. Education (aRR: 1.56; 95% CI: 1.31–1.85), farming experience (aRR: 1.27; 95% CI: 1.04–1.55), and age (aRR: 2.59; 95% CI: 1.06–1.59) were significant predictors of awareness. These findings underline key socio-demographic factors influencing knowledge of zoonotic poultry diseases among farmers.

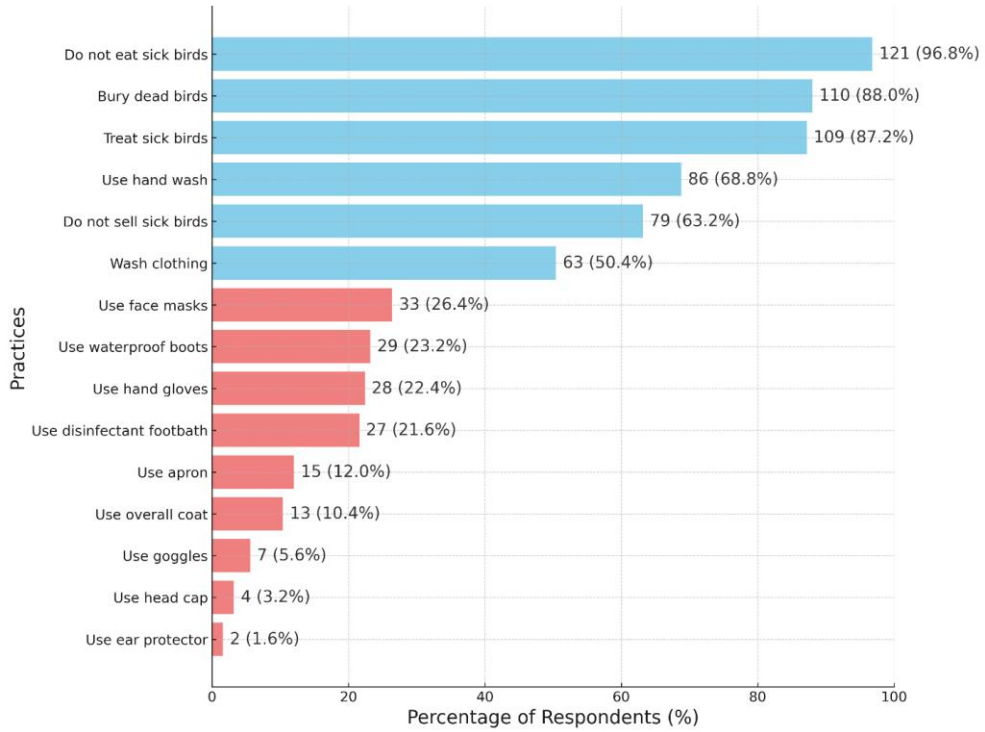


Figure 4. Percentage of poultry farmers adopting basic hygiene practices (blue bars) and personal protective equipment (PPE) use (red bars). Values are shown as the number of respondents and percentage of the total sample (n = 125) for each practice.

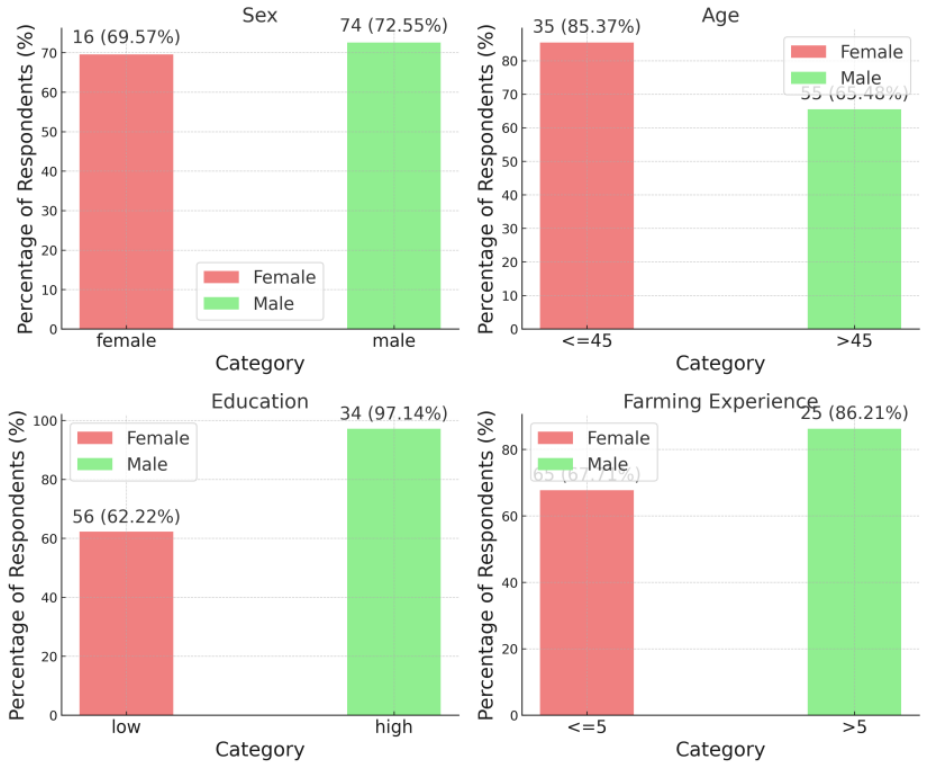


Figure 5. Percentage of knowledgeable poultry farmers by sex, education level, farming experience, and age group (n = 90). Bars represent the proportion of respondents classified as knowledgeable in each subgroup, with values showing both respondent count and percentage.

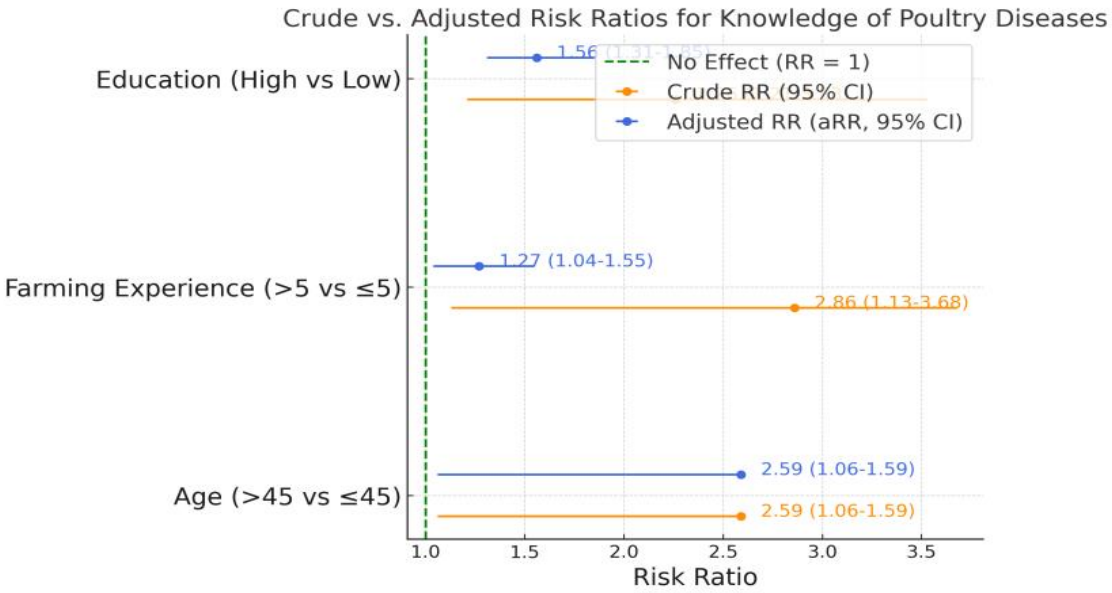


Figure 6. Crude and adjusted risk ratios (RR and aRR) for factors associated with poultry disease knowledge among (n = 90). The forest plot presents both crude and adjusted risk ratios with 95% confidence intervals for education level, farming experience, and age group. The green dashed line represents the null value (RR = 1), indicating no effect. Adjusted models highlight significantly higher knowledge among farmers with higher education, ≤5 years of experience, and age ≤45.

Table 1 summarizes the parameters linked with the adoption of self-protective behavior. Multivariable study indicated that farming experience and age are the major determinants of protective behavior. Farmers with little experience (up to 5 years) had a substantially higher propensity to adopt preventative measures than those with over five years of experience (aRR: 4.71; 95% CI: 1.77–5.79). Moreover, farmers above the age of 50 had a much greater propensity for uptake (RR: 1.32; 95% CI: 1.09–1.59). Although higher education had a favorable tendency in the first analysis, it did not emerge as a meaningful predictor after controlling for other factors (aRR: 1.10; 95% CI: 0.83–1.45). No notable disparities were detected in the gender of the farmers. The findings indicate that specialized biosecurity training might be especially advantageous for seasoned farmers who may have developed complacency over time.

Table 1: Factors associated with poultry disease knowledge influencing self-protective practices among farmers, including crude and adjusted risk ratios (n = 80).

Variable		Respondents	Percentage	Crude RR		Regression model	
				RR	95% CI	aRR	95% CI
Sex	Female	10	12.50		Ref.		
	Male	70	87.50	1.57	0.97-2.56		
Age (year)	Up to 50	11	13.80		Ref.		
	>50	69	86.2	1.32	1.09-1.59		
Education	Low level	56	70.00		Ref.	2.51	1.37-3.52
	High level	24	30.00	1.1	0.83-1.45		
Farming experience(Year)	Up to 5	72	90.00	2.71	1.49-4.95	4.71	1.77-5.79
	>5	8	10.00		Ref.		

Discussion

This study examines the knowledge and practices of poultry producers in northern Bangladesh with reference to zoonotic risks and poultry diseases. According to our analysis of the poultry farmers' sociodemographic data, there were four times as many male farmers as female farmers. This is consistent with another study on livestock farmers in Bangladesh that found a comparable ratio (Ahmed *et al.*, 2025). In contrast, a recent study found that women in Bangladesh were heavily involved in livestock husbandry, but their level of empowerment was low (Nath *et al.*, 2024). Heckert *et al.* (2023) suggest that men's dominance may stem from easier access to empowerment programs, capital, land, and decision-making roles in their various households. Our results show that more than 71% of the respondents had at least a secondary education, in

addition to the farmers' gender distribution. This suggests that more than one-third of the participants possess the fundamental abilities of reading and math. Our respondents' educational background is consistent with earlier studies that indicate farmers with at least a primary education are more prevalent than those without (Ahmed *et al.*, 2025). Better disease knowledge, particularly with regard to zoonotic diseases, was strongly correlated with the education and experience of farmers. Farmers who had recently received training or had a formal education demonstrated a greater comprehension of disease prevention and transmission. This result confirms previous research that found education is associated with more robust biosecurity procedures (Sarker *et al.*, 2016). It also supports a previous study that found a strong correlation between farmers' knowledge of zoonoses and their educational attainment. The farmers' degree of experience also suggests that most of them were first-time livestock farmers. This contrasts with a previous study that found that farmers with at least 15 years of experience were more likely to be experienced, and that this was substantially correlated with their level of zoonose knowledge. It's interesting to note that in our study, younger farmers with less than five years of experience were more inclined to take safety precautions than more seasoned farmers. This could be because they had access to more recent training and resources (Ali *et al.*, 2019).

The nature of the zoonosis seemed to be the driving force behind the knowledge gradient among the respondents, according to our assessment of the study area. In particular, a significant percentage of farmers said that they were aware of serious poultry diseases such as avian influenza (84%) and Newcastle disease (92%), which is consistent with other research highlighting these as significant risks to poultry farming in the area (Ali and Hasan, 2018). The farmers' level of knowledge in our study is in contrast to the results of a study conducted in Ethiopia on livestock farmers' knowledge in a local district, which found that their knowledge of zoonotic infections was only 66.80% (Abunna *et al.*, 2024). However, just 40.8% and 48.8% of farmers, respectively, were aware of salmonellosis and colibacillosis, two major zoonotic illnesses. As highlighted in previous studies (Neupane *et al.*, 2012; Akter, *et al.*, 2025). The fact that the farmers' educational backgrounds varied, with most of them majoring in subjects unrelated to livestock or agriculture, can account for the discrepancy between the claimed knowledge levels of the farmers in the various studies and our study. According to our study, the majority of farmers are aware of common diseases that affect poultry, many are not fully aware of zoonotic diseases and do not always take preventive measures. These gaps seriously threaten the health of both animals and the general public.

Even though knowledge was fairly good, putting it into practice was weak, and biosecurity measures were limited. While most farmers reported hygienic practices such as avoiding the consumption of sick birds (96.8%) and proper disposal of dead birds (88%), the use of personal protective equipment (PPE) was still very low. Our findings corroborated an earlier study that reported that over 70% of their respondents were not in the habit of consuming the milk and meat of dead animals, and aborted animals (Abunna *et al.*, 2024). Only 26.4% of respondents used face masks, and fewer than a quarter used gloves or waterproof boots. This behavior increases the risk of zoonotic transmission, especially in farm settings where human-animal interaction is routine (Alam *et al.*, 2019; Ali *et al.*, 2021b). The low level of PPE use in our study aligns with a recent study that also reported low levels of PPE use among health workers (Singh *et al.*, 2020). The low levels PPE stem from a plethora of factors that include economic constraints, limited availability, or because they don’t see it as necessary due to traditional practices.

Younger and better-educated farmers tended to use protection more often, likely due to being more involved with modern training programs and exposure to emerging disease concerns (Tiongco *et al.*, 2011). This observed pattern may be due to the fact that younger farmers, in terms of years of experience, may be more willing to adopt and adapt to new technologies and exhibit more openness to biosecurity measures, such as the use of PPE, proper waste disposal, and routine disinfection of farms (Chuang *et al.*, 2020). In contrast, the older and more experienced farmers, despite their wealth of experience or knowledge of farming over the years, may be more inclined to rely on outdated methods and their formed personal habits over time than on new technologies. This could stem from entrenched habits, limited exposure to updated guidelines, or skepticism towards novel approaches. This aligns with a study that showed that younger farmers are more likely to accept new technologies or changes compared to older farmers (Cao *et al.*, 2020). Put together, these stress the importance of ongoing training and behavioral change interventions (Bearth *et al.*, 2014; Ali and Islam, 2021; Ali *et al.*, 2020). This study highlights a clear need for specific educational efforts, improved access to training, and subsidized PPE distribution. Strengthening policy frameworks and working together with government and NGOs will be key to improving biosecurity standards and safeguarding both animal and human health in Bangladesh's poultry sector (Grace *et al.*, 2024; Odo *et al.*, 2015; Nicholson *et al.*, 2020; Ali *et al.*, 2021c).

Conclusion

This study reveals critical gaps in poultry farmers' understanding and practices related to zoonotic poultry diseases in northern Bangladesh. While awareness of common poultry diseases was high, knowledge of zoonotic risks and use of personal protective equipment (PPE) remained limited. Farmers with higher education, younger age, and shorter farming experience demonstrated significantly better knowledge. These findings emphasize the need for targeted training and affordable access to PPE. Future research should prioritize longitudinal studies to assess behavioral change sustainability and intervention trials to determine which training methods, such as peer-led workshops or mobile-based extension services, reduce farm-level zoonotic transmission risks.

Authors' contribution: Concept: MZA and MS; Experimental work: MZA, and MS; Data arrangement and analysis: MZA, MS, and MMM; Initial draft: MZA and MS; Critical review: MS, UOE, MMM and CM. Writing the final version of the manuscript: MZA and MS. All authors approved the final version of the manuscript.

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Availability of Data and Materials: The datasets used during the current study available from the corresponding author on reasonable request.

Clinical trial number: Not applicable.

Competing interests

The authors declare that they have no competing interests to declare that are relevant to the content of this article.

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