Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.
Poultry farming and farmers perception towards the farming condition during COVID-19 pandemic in Bangladesh

Mirza Mienur Meher\textsuperscript{a,}\textsuperscript{*}, Marya Afrin\textsuperscript{b}, Md Taimur Islam\textsuperscript{c}, Mohammad Ali Zinnah\textsuperscript{a}

\textsuperscript{a} Department of Microbiology and Public Health, Faculty of Veterinary Medicine and Animal Science, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur, 1706, Bangladesh
\textsuperscript{b} Department of Anatomy and Histology, Faculty of Veterinary Science, Bangladesh Agricultural University, Mymensingh, 2202, Bangladesh
\textsuperscript{c} Department of Pathobiology, Faculty of Veterinary Medicine and Animal Science, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur, 1706, Bangladesh

\textbf{ABSTRACT}

Coronavirus disease 2019 (COVID-19) is threatening global public health and has declared as a pandemic crisis around the world. An attempt was made to ascertain the effect of COVID-19 on practices in poultry farming (PPF), problem faced for poultry farming (PFPF) and poultry farmer’s perception on COVID-19. A questionnaire based cross-sectional study was conducted among 397 poultry farmers during the period of October to December 2020 in selected area of Bangladesh. The PPF score at just prior and during of the COVID-19 was 7.11 ± 3.25 and 6.53 ± 3.12 having significant difference ($p<0.01$). But, the training on poultry farming can improve the PPF score at just prior (7.57 ± 3.20) and during (6.91 ± 3.13) of the COVID-19. Additionally, the mean PFPF score was found of 10.67 ± 6.15. In logistic regression analysis, the farmers of >18–29 years aged and had no training, were 0.42 (95% CI:0.20–0.88; $p<0.01$) and 0.58 (95% CI:0.35–0.96; $p<0.05$) times respectively less likely to have satisfactory score on PPF. Similarly, the farmers of ≥18 to 29 and ≥40–49 years aged were 2.52 (95% CI:1.36–4.69; $p<0.01$) and 2.08 (95% CI:1.12–3.87; $p<0.05$) times respectively more likely to have considerable score on PFPF than the farmers of other age group. Interestingly, the internet users had 2.51 (95% CI:0.95–6.57; $p<0.05$) times higher to have more satisfactory PPF score ($≥60$%). Moreover, the farmers of ≥18–29 years aged, masters level education and had training, significantly ($p<0.01$) thought the COVID-19 is more dangerous indicated by the higher median (median = 8). In conclusion, the PPF and PFPF score was significantly varied by demographical characteristics of farmers. Therefore, the farmers had the concept about COVID-19 and more than 75% of them believe that COVID-19 doesn’t transmit from poultry.

\textbf{1. Introduction}

Coronavirus disease 2019 (COVID-19) is a highly contagious infectious disease threatening global public health and has declared as a pandemic crisis around the world [1,2]. The COVID-19 is caused by the most recently discovered coronavirus Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) [3] which is under the family of Coronaviridae a large family of enveloped, positive-sense RNA viruses that are important pathogens of humans and other mammals [4]. In 2003 and 2012, two deadly human Coronavirus (CoV), namely SARS-CoV and MERS-CoV, have emerged respectively [5]. Recently, the SARS-CoV-2 is a third new type of CoV, which is even more pathogenic, is straightening across the world in an unparalleled manner. In Bangladesh, the first-ever confirmed case was reported on March 8, 2020 [6]. In these contrast, several strategies have been executing to control the COVID-19, some of them concerning to the social distancing, hand washing, lockdown measures and etc. [7]. To combat against the COVID-19, it is essential to boost up the body immunity and animal originated protein and fiber enriched foods play a crucial role for this perseverance [8]. In Bangladesh, about 37% of all animal protein meat consumption comes from poultry [9]. Particularly, about 65–70 thousand commercial poultry farms are currently operating all over the country [10]. Moreover, poultry rearing by women is common practice in almost all families in villages and plays a crucial role in self-employed and livelihood advancement of the poor women. The commercials poultry farms of about 65–70 thousand are contribution to produce...
considered the different areas across the country located between 20 October to December 2020 in Bangladesh (Fig. 1). The study areas were COVID-19 was also considered through the study. Hence, an attempt has been made to ascertain the poultry farming practices and farmers problem with perceptions on COVID-19. This relevant information could be a major bottleneck for having a better understanding about the impact of the pandemic COVID-19 on poultry farming during this period has been phenomenal. It is additional envisioned that the effect would continue to be enduring and may have boundless carrying on the livelihood and economy of the sector. Though, all associated issues are being addressed but this poultry sectors need a strong might in these days. Consistently, a holistic appreciation of the overall impact would support in drawing suitable policies and reinforcement strategies for this sub-sector. However, there is an inadequacy of relevant studies in the aspects of poultry farming practices and farmers problem with perceptions on COVID-19. This relevant information could be a major bottleneck for having a better understanding about the impact of the pandemic COVID-19 on poultry farming. Hence, an attempt has been made to ascertain the practices for poultry farming and problem faced for poultry farming during this pandemic situation. Herewith, farmers’ perception about COVID-19 was also considered through the study.

2. Materials and methods

2.1. Study area and design

A cross-sectional survey of poultry farmers was carried out from October to December 2020 in Bangladesh (Fig. 1). The study areas were considered the different areas across the country located between 20°34′ to 26°38′ north latitude and 88°01′ to 92°41′ east longitude.

2.2. Sampling procedure and data collection

The data were collected through a structured questionnaire. In this study, a total of 397 poultry farmers was considered, who agreed to participate and all were face to face interviewed. Sample size was determined according to existing poultry farm in that market linked area, from which 5% poultry farmer was considered in this study. The only unwillingness to participate was the exclusion criteria.

2.3. Questionnaire

A structured questionnaire has been designed by the authors which included the four section. The first section of the questionnaire on socio-demographic of poultry farmers included: category age, gender, education, training and experiences on poultry farming. The second section on practices in poultry farming (PPF). The third section was on problem facing in poultry farming during COVID-19 (PPPF) and lastly the poultry farmer’s perceptions on COVID-19. Briefly, the PPF consisted with 15 questions that were focusing the rearing system, regular vaccination and deworming, use of probiotics, veterinarian and chicken sellers’ visits farm, maintain farm register, disinfection of clothing and equipment’s, hand washing, use of face mask and wearing hand gloves while handling sick birds and restriction on the movement of people, vehicles and equipment in farm area. Particularly, the second section, the questions on PPF is divided into two partitions with the same questions; one is for practicing in poultry farm just prior the COVID-19 and another for during the COVID-19 pandemic. In the PPF section, the questions addressed the problem on poultry farming, channel of the poultry business, economic status, collection of DOC and poultry feed, supply of poultry medicine, communication with poultry market, availability of labour or manpower and disposing the farm wastage in COVID-19 situation. In the last section, the poultry farmer’s perceptions was assessed by setting the 9 questions regarding the COVID-19 and its etiological agent, transmission, source of information, willingness to participation on training and common information tools like internet or other media. Moreover, the three questions had the possible answers in liker scale 1 to 10 (very low to 10 very high).

2.4. Variable description and data analysis

The responses included dichotomous and categorical outcomes (Yes/No; Frequently/Often/None’), ordinal outcomes (5-point likert scale type: Very heavily/Heavily/Moderately/Slightly/Not at all) and responses were recoded into binary outcomes with 1 for the correct answers ‘Yes’ and 0 for inappropriate response ‘No’. On the other hand, the response of “Frequently”, “Often” and “None” has been...
assign 2, 1 and 0 point respectively. The total scores were ranged from 0 to 18. In the other section, the PPF score consisted of 9 items, and the response of each item was indicated on a 4-point Likert scale as follows 4 (“Very heavily”), 3 (“Heavily”), 2 (“Moderately”), 1 (“Slightly”) and 0 (“Not at all”). The total scores were calculated by summing the raw scores of the 9 questions ranging from 0 to 36. Respondents receiving scores greater than the mean scores, for PPF (14.7 ± 2.3) were deemed to be satisfactory responses and PPF (10.9 ± 2.7) were esteemed as considerable problem and vice versa [12]. Data entry and analysis were performed using Microsoft Excel 2010 (Microsoft Corporation, Redmond, WA, USA) and IBM SPSS Statistics (ver. 25.0). The demographic characteristics of the respondents, the category level of PPF and the perceptions of poultry farmers were subjected to Pearsons’ Chi-square test. Particularly, when the expected count less than 5 was in more than 20% cells of 2 × 2 contingency table, then the P value of continuity correction was considered but when the table was not 2 × 2 contingency then p value of Fisher exact tests was accounted. The differences between the PPF score of just prior and during of the COVID-19 was measured by paired t-test. As applicable, the association of PPF score among the various responses of socio-demographic characteristics of the participant were analysed by using individual t-test and one-way ANOVA. The Binary logistic regression analysis using demographic variables was performed with a 95% confidence interval to determine significant associations with the score of PPF and PPF. Moreover, the Binary logistic regression analysis also conducted to determine the association between outcome variable (satisfactory practices during COVID-19) and all variables associated with participant’s perception. According to the fitted assumption, either Mann-Whitney or Kruskal-Wallis test was used to assess the differences within the distribution of ordinal variables expressed by 1–10 Likert scale in boxplot among the demographic characteristics of the participants.

3. Result

3.1. Socio-demographics characteristics

Out a total of 397 poultry farmers investigated, most of them were male (92.9%), aged between 30 and 39 year old (32.7%). Almost, 33.5% of respondents had secondary education level and 73.8% had no training on poultry farming. Less than half of respondents (46.9%) had experience in poultry farming for at least 5 year and kept predominantly broilers (43.6%) in their farm (Table 1).

3.2. Score of PPF (just prior and during the COVID-19)

As is shown in Table 2, overall, the mean score of PPF of the poultry farmer in the study area was significantly (p < 0.01) higher prior the COVID 19 (7.11 ± 3.25) than during the disease outbreak (6.53 ± 3.12). Farmers aged between 40 and 49 years had higher PPF score prior (7.82 ± 3.38) and during (7.17 ± 3.11) COVID 19. Moreover, the poultry farmers having the master’s level of education had the higher PPF of 8.63 ± 4.1 and 8.04 ± 3.86 at just prior and during the COVID-19, and differed significantly (p < 0.01). Training on poultry farming improve the PPF score both the prior and during the COVID-19 indicated by the mean of 7.57 ± 3.20 and 6.91 ± 3.15 respectively. Poultry farmers with at least secondary level of education had a significantly (p < 0.01) higher PPF mean score prior and during COVID-19 than primary or illiterate categories. The mean PPF score of poultry farmer who raised broiler was significantly (p < 0.01) higher prior the COVID-19 (7.68 ± 3.31) than during the disease outbreak (7.05 ± 3.14).

3.3. Score of PPF during COVID 19 pandemic

Overall, during Covid-19 pandemic, the mean PPF score of 10.67 ± 6.15 was obtained. The mean score obtained from farmer aged between 30 and 39 years (11.36 ± 6.37) and 40 to 49 (11.66 ± 6.39) years old was significantly (p < 0.005) higher than that observed with other age categories. Also farmer with 15–19 years’ experience in poultry farming had a significantly (p < 0.005) higher mean PPF score (14.12 ± 8.39) compared to others (Table 2).

3.4. Binary logistic regression analysis on score of PPF (just prior and during the COVID-19) and PFPF (during the COVID-19 pandemic)

Binary logistic regression was performed to assess the impact of several demographic variable on the likelihood that the satisfactory PPF score (just prior and during the COVID-19 pandemic) and considerable PPF score during COVID 19 pandemic. The full models of PPF just prior COVID-19 pandemic and PPF during the COVID-19 pandemic containing all predictors was statistically significant (p < 0.01) where \( \chi^2(18, N = 397) = 52.489, 44.941 \) and indicating that the model was able to distinguish between farms whose PPF score was either satisfactory or not. Similarly, the model of PPF during COVID 19 pandemic was statistically significant, \( \chi^2(18, N = 397) = 31.231, (p < 0.05) \) and able to distinguish between farms had PPF score either considerable or not. Hence, the P value (p > 0.05) of Hosmer and Lemeshow test for all the three-model indicated that final model is fit. The model for PPF just prior COVID-19 pandemic, as a whole explained between 12.4% (Cox and Snell R square) and 16.6% (Nagelkerke R squared) of the variance in PPF status. As shown in Table 3, only farmers training variables made a unique statistically significant contribution to the model and had recording a lower odd ratio of 0.44 (95% CI: 0.25–0.76; p < 0.001) indicating that for every additional farmer had no training on poultry farming were 0.44 times less likely to have satisfactory score on PPF than the farmers who had training on poultry farming. In case of the model for PPF during of the COVID-19 pandemic, as a whole explained between 10.7% (Cox and Snell R square) and 14.3% (Nagelkerke R squared) of the variance in PPF status. As shown in Table 3, farmers of ≥ 18–29 years aged and had no training were 0.42 (95% CI: 0.20–0.88; p < 0.01) and 0.58 (95% CI: 0.35–0.98; p < 0.05) times respectively less likely to have satisfactory score on PPF. Lastly, in the model of PPFF

**Table 1** Demographic characteristics of participants (N = 397).

| Variables                | Frequencies | Percentages | \( \chi^2 \)  | Effect Size |
|--------------------------|-------------|-------------|----------------|-------------|
| Age of the Farmers       |             |             |                |             |
| ≥18 to 29                | 67          | 16.9        | 247.57**       | 0.156       |
| ≥30 to 39                | 130         | 32.7        | 292.90**       | 0.738       |
| ≥40 to 49                | 109         | 27.5        | 247.57**       | 0.156       |
| ≥50                      | 91          | 22.9        | 247.57**       | 0.156       |
| Gender of the Farmer     |             |             |                |             |
| Male                     | 369         | 92.9        |                 |             |
| Female                   | 28          | 7.1         |                 |             |
| Educational Status       |             |             | 148.61**       | 0.075       |
| Illiterate               | 89          | 22.4        |                 |             |
| Primary                  | 85          | 21.4        |                 |             |
| SSC                      | 133         | 33.5        |                 |             |
| HSC                      | 89          | 22.4        |                 |             |
| Bachelor                 | 49          | 12.3        |                 |             |
| MSc                      | 17          | 4.3         |                 |             |
| Training on farming      |             |             | 89.98**        | 0.227       |
| Yes                      | 104         | 26.2        |                 |             |
| No                       | 293         | 73.8        |                 |             |
| Experience on Farming    |             |             | 247.57**       | 0.156       |
| <5 years                 | 186         | 46.9        |                 |             |
| 5–9 years                | 114         | 28.7        |                 |             |
| 10–14 years              | 47          | 11.8        |                 |             |
| 15–19 years              | 33          | 8.3         |                 |             |
| ≥20 years                | 17          | 4.3         |                 |             |
| Farm species             |             |             |                 |             |
| Broiler                  | 173         | 43.6        | 34.22**        | 0.043       |
| Layer                    | 144         | 36.3        |                 |             |
| Sonali                   | 80          | 20.2        |                 |             |

**Significant at % (p < 0.01), \( \chi^2 = \) Chi square value.
Table 2
Demographic characteristics of poultry producers influencing the PPF (just prior and during the COVID-19 pandemic) and PFPF during the COVID 19 pandemic.

| Variables                           | Score on Poultry Farm Practices | Problem Score |
|-------------------------------------|---------------------------------|---------------|
|                                     | (Mean ± SD) F value             | (Mean ± SD) F value |
|                                     | t value i                       | t value ‡      |
|                                      |                                  |               |
|                                      | Praticepractices                | Praticepractices |  |
|                                      | (Mean ± SD) F value             | (Mean ± SD) F value |
|                                      | t value i                       | t value ‡      |  |
| Age of the Farmers                  |                                  |               |
| ≥18 to 29                           | 6.45 ± 2.95 2.86*               | 5.69 ± 2.76 3.28* 3.381** 9.25 ± 5.76 3.82 ** |
| ≥30 to 39                           | 7.00 ± 3.17 1.37               | 6.49 ± 3.24 1.593 11.36 ± 6.37 |
| ≥40 to 49                           | 7.82 ± 3.36                     | 7.17 ± 3.11 3.951** 11.66 ± 6.39 |
| ≥55                                 | 6.90 ± 3.31                     | 6.42 ± 3.09 3.689** 9.52 ± 5.49 |
| Gender of the Farmer                |                                  |               |
| Male                                | 7.09 ± 3.23 0.85               | 6.49 ± 3.10 0.82 7.286** 10.60 ± 6.13 –0.81 |
| Female                              | 7.36 ± 3.48                     | 7.07 ± 3.33 1.441 11.57 ± 6.43 |
| Educational Status                  |                                  |               |
| MSc                                 | 8.63 ± 4.11 4.01**              | 8.04± 3.86 3.39** 3.245** 9.58 ± 4.92 0.26 |
| Bachelor                            | 8.09 ± 3.95                     | 7.24± 2.89 4.145** 10.75 ± 5.74 |
| HSC                                | 6.64 ± 3.14                     | 6.07± 3.10 4.397** 10.66 ± 5.56 |
| SSC                                | 7.16 ± 3.00                     | 6.57± 2.82 3.458** 11.00 ± 7.21 |
| Primaty                            | 6.24 ± 3.08                     | 5.69± 2.84 2.380* 10.29 ± 6.54 |
| Illiterate                          | 6.29 ± 3.47                     | 6.59± 4.32 0.925 11.18 ± 6.85 1.67 |
| Training on farming                |                                  |               |
| No                                  | 5.82 ± 3.04 0.22               | 5.43 ± 2.83 1.17 2.783** 11.53 ± 6.30 |
| Yes                                 | 7.57 ± 3.20                     | 6.91 ± 3.13 6.932** 10.36 ± 6.08 |
| Experience on Farming              |                                  |               |
| <5 years                            | 6.89 ± 3.26 1.55               | 6.40 ± 3.01 1.23 2.192* 10.19 ± 5.87 3.13* |
| 5-9 years                           | 6.96 ± 3.02                     | 6.36 ± 2.97 3.776** 10.65 ± 5.82 |
| 10-14 years                         | 7.45 ± 3.35                     | 6.42 ± 3.36 5.553** 9.06 ± 5.69 |
| 15-19 years                         | 6.73 ± 3.37                     | 6.27 ± 3.16 1.873 14.12± 8.39 |
| ≥20 years                           | 5.71 ± 3.06                     | 5.29 ± 2.62 1.383 11.18 ± 5.96 |
| Farm species                        |                                  |               |
| Broiler                             | 7.68± 3.31 5.04**               | 7.05± 3.14 4.33* 5.301** 11.45 ± 5.90 2.55 |
| Layer                               | 6.58± 3.00                      | 6.11± 3.07 3.688** 9.96 ± 6.10 |
| Sonali                              | 6.83± 3.38                      | 6.15± 3.03 3.725** 10.25 ± 6.62 |
| Total                               | 7.11 ± 3.25                     | 6.53 ± 3.12 7.421** 10.67 ± 6.15 |
| Number of birds during practices    | 2952.63±4364.72                 | 2678.259±4503.56 2.895** |

** Significant at 1% (p < 0.01).
* Significant at 1% (p < 0.05).
abc: Columns values with same letters do not differ significantly.
† = Independent sample T test.
¥ = One way ANOVA.
£ = Paired t-test.
Practices just prior the outbreak of COVID-19.
Practices just beginning of the outbreak of COVID-19.

during COVID-19 pandemic, as a whole explained between 07.6% (Cox and Snell R square) and 10.1% (Nagelkerke R squared) of the variance in PFPF status. As shown in Table 3, farmers of ≥18 to 29 and ≥40–49 years aged were 2.52 (95% CI: 1.36–4.69; p < 0.01) and 2.08 (95% CI: 1.12–3.87; p < 0.05) times respectively more likely to have considerable score on PFPF than the farmers of other age group.

3.5. Assessment of problem facing on poultry farming (PFPF) during COVID 19 pandemic

As concerns the problem facing in poultry farming, 32.5% of the respondents said that COVID-19 heavily hinder the poultry farming. Almost, 36.3% of the respondents indicated that COVID-19 affects the poultry channels business while 32.2% reported the economic losses at the beginning of the pandemic. Less than 15% of poultry farmers indicated a slightly problem for supply of poultry medicine during COVID-19 pandemic (Table 4).

Lastly, the response rates of “not at all” were 85.4% to “problem in disposing the farm wastage during COVID-19”.

3.6. Perception about COVID-19 pandemic and analysis of binary logistic regression on more satisfactory PPF score (≥60%)

As is presented in Table 5, the 74.1% and 75.8% farmers gave the correct answer about the etiological agent and modes of transmission of COVID-19 respectively which have significant association with the more satisfactory PPF score (≥60%). Besides this, regarding the internet user, 53.7% farmers responded to yes. On the other side, 89.2% farmers answered that they had not attained in any meeting/training/seminar on COVID-19. Both of this statement had significant association with the more satisfactory PPF score (≥60%). Considering the regression analysis, the farmers answered correctly to modes of transmission of COVID-19 had 2.03 (95% CI: 1.04–3.95; p < 0.05) times more likely to have more satisfactory PPF score (≥60%) than who gave the wrong answer. Similarly, the farmers who are internet users had 2.51 (95% CI: 0.95–6.57; p < 0.05) times higher to have more satisfactory PPF score (≥60%). The majority of farmers reported that they are known about the COVID-19 is a contagious disease (91.4%). These farmers were asked to assess their concept, danger and interest about COVID-19 on a 1 to 10 likert scale (1 = very low, 10 = very high) (Fig. 2). The farmers of ≥18–19 years aged and had masters level education, scored themselves to have significantly more concept on the COVID-19 issue where the median was 6 and 8 respectively. The trained (median = 6) farmers had more concepts than who had no training and the differences were statistically significant according to the Mann–Whitney test (p < 0.01). Moreover, the farmers of ≥18–29 years aged, masters level education and had training, thought that the COVID-19 is more dangerous, reflected by the higher median (median = 8) which had significant (p < 0.01) difference. In terms of percipients interest on dipping the knowledge on COVID-19, the farmers who had master’s level of education, training and sonali chicken farms were more interested indicating by their higher median (median = 7) having significant (p < 0.01) difference.

4. Discussion

In this study, the impact of COVID-19 on poultry farming was determined in relation with the different demographic variables of poultry farmers. The proportion of male and female farmers had grater variation reflected by the effect size. Though the findings of Meher et al. [13] suggested that the proportion of male farmers was high, but it may vary on socioeconomic conditions in different regions in Bangladesh.
and treatment measures [15]. However, the farmers of population will conform better about any given disease to the preventive also had the linkage with PPF, because we also found higher PPF score to comparatively than others [14]. The practices on personal protection tion. The people having the masters-

The total mean score of PFP was lower during COVID-19 than that observed prior the outbreak. This lower score of PPF during COVID-19 might be due to divesting effect on normal life in this pandemic situation. The people having the masters’ level of education and more than 30 years of ages more frequently practiced to personal protection comparatively than others [14]. The practices on personal protection also had the linkage with PPF, because we also found higher PPF score to this level than others. Moreover, the trained, and experienced farmers improved their poultry farming [2] with better PPF score. On the other hand, the farmers having the master’s degree had highest PPF score and lowest PFPF score. It is common consensus that a more educated population will conform better about any given disease to the preventive and treatment measures [15]. However, the farmers of ≥40-49 years ages and experience of 15-19 years, reported that they faced more problems on farming. It might be due to the more experienced farmers are able to identify the more problem than the less experienced f. Moreover, comparatively older had more fear to contracting COVID-19 [16]. Among the problem statements, highest number of farmers responded to heavily problem for the statement of COVID-19 hinder poultry farming, economic losses by poultry farming during COVID-19 as well as affected the channel of the poultry business. This might be due to the inadequate transportation facilities and the lack of value chain actors or middle-men which may hindered the proper distribution. As a result, leading to the deterioration of farm products and unexpected price down at the producer level [10]. However, most of the farmers reported that the statements regarding PFPF were due to the inadequate transportation facilities and the lack of value chain actors or middle-men which may hindered the proper distribution. As a result, leading to the deterioration of farm products and unexpected price down at the producer level [10]. However, most of the farmers reported that the statements regarding PFPF were due to the inadequate transportation facilities and the lack of value chain actors or middle-men which may hindered the proper distribution. As a result, leading to the deterioration of farm products and unexpected price down at the producer level [10]. However, most of the farmers reported that the statements regarding PFPF were due to the inadequate transportation facilities and the lack of value chain actors or middle-men which may hindered the proper distribution. As a result, leading to the deterioration of farm products and unexpected price down at the producer level [10]. However, most of the farmers reported that the statements regarding PFPF were due to the inadequate transportation facilities and the lack of value chain actors or middle-men which may hindered the proper distribution. As a result, leading to the deterioration of farm products and unexpected price down at the producer level [10]. However, most of the farmers reported that the statements regarding PFPF were due to the inadequate transportation facilities and the lack of value chain actors or middle-men which may hindered the proper distribution. As a result, leading to the deterioration of farm products and unexpected price down at the producer level [10]. However, most of the farmers reported that the statements regarding PFPF were due to the inadequate transportation facilities and the lack of value chain actors or middle-men which may hindered the proper distribution. As a result, leading to the deterioration of farm products and unexpected price down at the producer level [10]. However, most of the farmers reported that the statements regarding PFPF were due to the inadequate transportation facilities and the lack of value chain actors or middle-men which may hindered the proper distribution. As a result, leading to the deterioration of farm products and unexpected price down at the producer level [10]. However, most of the farmers reported that the statements regarding PFPF were due to the inadequate transportation facilities and the lack of value chain actors or middle-men which may hindered the proper distribution. As a result, leading to the deterioration of farm products and unexpected price down at the producer level [10]. However, most of the farmers reported that the statements regarding PFPF were due to the inadequate transportation facilities and the lack of value chain actors or middle-men which may hindered the proper distribution. As a result, leading to the deterioration of farm products and unexpected price down at the producer level [10]. However, most of the farmers reported that the statements regarding PFPF were due to the inadequate transportation facilities and the lack of value chain actors or middle-men which may hindered the proper distribution. As a result, leading to the deterioration of farm products and unexpected price down at the producer level [10]. However, most of the farmers reported that the statements regarding PFPF were due to the inadequate transportation facilities and the lack of value chain actors or middle-men which may hindered the proper distribution. As a result, leading to the deterioration of farm products and unexpected price down at the producer level [10]. However, most of the farmers reported that the statements regarding PFPF were due to the inadequate transportation facilities and the lack of value chain actors or middle-men which may hindered the proper distribution. As a result, leading to the deterioration of farm products and unexpected price down at the producer level [10]. However, most of the farmers reported that the statements regarding PFPF were due to the inadequate transportation facilities and the lack of value chain actors or middle-men which may hindered the proper distribution. As a result, leading to the deterioration of farm products and unexpected price down at the producer level [10]. However, most of the farmers reported that the statements regarding PFPF were due to the inadequate transportation facilities and the lack of value chain actors or middle-men which may hindered the proper distribution. As a result, leading to the deterioration of farm products and unexpected price down at the producer level [10]. However, most of the farmers reported that the statements regarding PFPF were due to the inadequate transportation facilities and the lack of value chain actors or middle-men which may hindered the proper distribution. As a result, leading to the deterioration of farm products and unexpected price down at the producer level [10]. However, most of the farmers reported that the statements regarding PFPF were due to the inadequate transportation facilities and the lack of value chain actors or middle-men which may hindered the proper distribution. As a result, leading to the deterioration of farm products and unexpected price down at the producer level [10]. However, most of the farmers reported that the statements regarding PFPF were due to the inadequate transportation facilities and the lack of value chain actors or middle-men which may hindered the proper distribution. As a result, leading to the deterioration of farm products and unexpected price down at the producer level [10]. However, most of the farmers reported that the statements regarding PFPF were due to the inadequate transportation facilities and the lack of value chain actors or middle-men which may hindered the proper distribution. As a result, leading to the deterioration of farm products and unexpected price down at the producer level [10]. However, most of the farmers reported that the statements regarding PFPF were due to the inadequate transportation facilities and the lack of value chain actors or middle-men which may hindered the proper distribution. As a result, leading to the deterioration of farm products and unexpected price down at the producer level [10]. However, most of the farmers reported that the statements regarding PFPF were due to the inadequate transportation facilities and the lack of value chain actors or middle-men which may hindered the proper distribution. As a result, leading to the deterioration of farm products and unexpected price down at the producer level [10]. However, most of the farmers reported that the statements regarding PFPF were due to the inadequate transportation facilities and the lack of value chain actors or middle-men which may hindered the proper distribution. As a result, leading to the deterioration of farm products and unexpected price down at the producer level [10]. However, most of the farmers reported that the statements regarding PFPF were due to the inadequate transportation facilities and the lack of value chain actors or middle-men which may hindered the proper distribution. As a result, leading to the deterioration of farm products and unexpected price down at the producer level [10]. However, most of the farmers reported that the statements regarding PFPF were due to the inadequate transportation facilities and the lack of value chain actors or middle-men which may hindered the proper distribution. As a result, leading to the deterioration of farm products and unexpected price down at the producer level [10]. However, most of the farmers reported that the statements regarding PFPF were due to the inadequate transportation facilities and the lack of value chain actors or middle-men which may hindere...
chickens, turkeys, ducks, quail, and geese are unlikely to serve a role in majority of them did not believe that the COVID-19 can transmit from human to poultry and vice versa. In fact, the poultry species, such as chickens, turkeys, ducks, quail, and geese are unlikely to serve a role in transmission of either severe acute respiratory syndrome coronavirus 2 or Middle East respiratory syndrome coronavirus [19]. Because, these viruses cannot replicate in these host range, resulting there is no any etiological agent and modes of transmission of COVID-19. But most of their PPF score was below average. This might be due to lack of awareness. Similarly, some of other study reported that the participants also faced problem to create awareness among their family members [14]. Interestingly, most of the farmers were known that COVID-19 does not transmit from poultry to human and vice versa. The other authors Rahman and Das [10] reported that 69.8% respondents of their study had the appropriate knowledge on transmission of COVID-19. Additionally, 53.7% were internet users but most of them had the PPF score to the below the average. The majority of young adults Bangladeshi relying on the internet in their regular lifestyle and during lockdown initiative amid COVID-19 which is increased by 15–20% [17]. On the other side, the internet as well as Television were the main source of information for the participants about COVID-19 [12]. Among the different Information tools for having information, farmers preferred the classroom-based training; because they were might be habituate on class room-based information. According to likert scale, the most of the participants thought that the COVID-19 could be dangerous for public health. Similarly, the authors Banik et al. [17] reported that 55.3% participants believed that COVID-19 is a deadly disease. In addition, majority of them did not believe that the COVID-19 can transmit from poultry to human and vice versa. In fact, the poultry species, such as chickens, turkeys, ducks, quail, and geese are unlikely to serve a role in

Table 5
Farmer’s perception about COVID-19 pandemic and analysis of Binary logistic regression on Satisfactory PPF score (>60%) during COVID-19 pandemic.

| Statements                                                                 | Levels       | PPF Score | P-value | Univariate Logistic Regression |
|---------------------------------------------------------------------------|--------------|-----------|---------|--------------------------------|
|                                                                           | n (%)        | Low (%)   | Satisfactory (%) | OR | 95%CI | p-value |
| COVID-19 is a contagious disease                                          | Yes          | 363 (91.4)| 326 (89.8) | 37 (10.2) | 0.294<sup>a</sup> | >1 |
|                                                                           | No           | 34 (8.6)  | 28 (82.4) | 6 (17.6)  | 0.001<sup>a</sup> | Ref. |
|                                                                           | Correct answer| 294 (74.1)| 271 (92.2) | 23 (7.8)  | 0.35 | 0.18–0.67 | 0.00 |
|                                                                           | Wrong answer | 103 (25.9)| 83 (80.6) | 20 (19.4) | Ref. |
| Modes of transmission of COVID-19                                         | Correct answer| 301 (75.8)| 274 (91.0) | 27 (9.0)  | 0.035<sup>a</sup> | 2.03 | 1.04–3.95 | 0.04 |
|                                                                           | Wrong answer | 96 (24.2) | 80 (83.3) | 16 (16.7) | Ref. |
| Have attained in any meeting/training/seminar on COVID-19                 | Yes          | 43 (10.8) | 43 (100.0)| 0 (0.0)   | 0.031<sup>b</sup> | >1 |
|                                                                           | No           | 354 (89.2)| 311 (87.9)| 43 (12.1) | Ref. |
| COVID-19 can transmit from poultry to human                               | Yes          | 95 (23.9) | 86 (90.5) | 9 (9.5)   | 0.625<sup>a</sup> | 0.83 | 0.38–1.79 | 0.63 |
|                                                                           | No           | 302 (76.1)| 268 (88.7)| 34 (11.3) | Ref. |
| COVID-19 can transmit from human to poultry                               | Yes          | 88 (22.2) | 81 (92.0) | 7 (8.0)   | 0.325<sup>a</sup> | 0.66 | 0.28–1.53 | 0.33 |
|                                                                           | No           | 309 (77.8)| 273 (88.3)| 36 (11.7) | Ref. |
| Internet user                                                             | Yes          | 213 (53.7)| 197 (92.5)| 16 (7.5)  | 0.022<sup>a</sup> | 0.47 | 0.25–0.91 | 0.02 |
|                                                                           | No           | 184 (46.3)| 157 (85.3)| 27 (14.7) | Ref. |
| Source of information about COVID-19                                       | Television   | 285 (71.8)| 254 (89.1)| 31 (10.9) | 0.369<sup>c</sup> | 0.59 | 0.26–1.39 | 0.23 |
|                                                                           | Newspaper    | 5 (1.3)   | 5 (100.0)| 0 (0.0)   | 0.00 | 0.00–1.00 | 1.00 |
|                                                                           | Internet     | 60 (15.1) | 56 (93.3)| 4 (6.7)   | 0.35 | 0.10–1.24 | 0.10 |
|                                                                           | People/Others| 47 (11.8) | 39 (83.0)| 8 (17.0)  | Ref. |
| Information tools prefer for having information                            | Classroom-based training | 133 (33.5) | 116 (87.2)| 17 (12.8) | 0.202<sup>a</sup> | 2.22 | 0.84–5.87 | 0.11 |
|                                                                           | Online training courses | 29 (7.3) | 27 (93.1)| 2 (6.9)   | 1.12 | 0.21–5.89 | 0.89 |
|                                                                           | Paper documents | 11 (2.8) | 11 (100.0)| 0 (0.0)   | 0.00 | 0.00–1.00 | 1.00 |
|                                                                           | Veterinarian of the farm | 127 (32.0)| 109 (85.8)| 18 (14.2) | 2.51 | 0.95–6.57 | 0.06 |
|                                                                           | Media        | 97 (24.4) | 91 (93.8)| 6 (6.2)   | Ref. |

<sup>a</sup> Pearson’s chi-square test.
<sup>b</sup> After continuity correction.
<sup>c</sup> Fisher exact tests, Ref. = Reference category. Highly significant at 1% (p < 0.01), Significant at 5% (p < 0.05). CI = Confidence Interval; OR = Odd Ratio. χ² = Chi square value; n = Frequencies; % = Percentages; PPF = Practices in poultry Farm.

4.1. Limitations

This study had some limitations. First, the data was collected from different place or region in which there might have a chance of variation due to socioeconomic condition. Secondly, the other natural disaster like flood also may have influence on poultry farming, which could affect our data. Third, due to COVID-19, it was challenging to collect the data by face-to-face interviews, has limitations including few biases. Lastly, we
used a limited number of questions to measure the level.

5. Conclusion

The COVID 19 had an overriding significance toward the poultry farming in terms of regular farm economy. The regular practices in poultry farming was significantly hindered by the COVID-19 pandemic situation. The farmers faced remarkable problem in farming but in later most of them were able to minimize the problem score to moderate level. The PPF and PFPF scores were significantly varied by demographic characteristics of farmers. The farmers had the good concept on COVID-19 and its mode of transmission. Interestingly, the farmers had higher scale of interest on dipping the knowledge on COVID-19. However, this study is the initial which could be helpful for further research on COVID-19 and its impact for designing the better strategy to minimize the adverse effect on poultry farming.

Authors contribution

MMM involved in conception and design of the experiments, questionnaire development, statistical analysis and manuscript writing. MA contributed to revise the manuscript. MTI and MAZ monitor the data collection process. All authors read and approved the manuscript and also contributed it critically for important intellectual content.
Declaration of competing interest

There is no conflict of interest among the authors.

Acknowledgement

The authors would like to acknowledge the student of DVM 3rd year, Summer Term-2020 (Batch: 2018), for their cordial help in data collection from the poultry farmers.

References

[1] M.A. Lake, What we know so far: COVID-19 current clinical knowledge and research, Clin. Med. 20 (2020) 124–127, https://doi.org/10.7861/cclinmed.2019-coron.

[2] N.C. Choudhuri, G. Paul, A.K. Majit, M.S. Kundu, A. Kundu, Impact of training on poultry farming and evaluation of improved Nicobari fowl under intensive and extensive management systems in Andaman, India, Livest. Res. Rural Dev. 21 (2009) 26, https://doi.org/10.23750/lrrv.9111.9397.

[3] S. Ruan, Likelihood of survival of coronavirus disease 2019, Lancet Infect. Dis. 20 (2020) 630–631, https://doi.org/10.1016/S1473-3099(20)30257-7.

[4] A.R. Fehr, S. Perlman, Coronaviruses: an overview of their replication and pathogenesis, in: H.J. Maier, E. Bickerton, P. Britton (Eds.), Coronaviruses Methods Protoc., Springer New York, New York, USA, 2015, pp. 1–23.

[5] T. Chen, D. Wu, H. Chen, W. Yan, D. Yang, G. Chen, K. Ma, D. Xu, H. Yu, H. Wang, T. Wang, W. Guo, J. Chen, C. Ding, X. Zhang, J. Huang, M. Han, S. Li, X. Luo, J. Zhao, Q. Ning, Clinical Characteristics of 113 Deceased Patients with Coronavirus Disease 2019: Retrospective Study, BMJ 368 (2020), https://doi.org/10.1136/bmj.m1091.

[6] R. Banik, M. Rahman, T. Sikder, D. Gozal, COVID-19 in Bangladesh: public awareness and insufficient health facilities remain key challenges, Publ. Health 183 (2020) 102083, https://doi.org/10.1016/j.puhe.2020.04.037.

[7] D. Roy, S. Tripathy, S.K. Kar, N. Sharma, S.K. Verma, V. Kaushal, Study of knowledge, attitude, anxiety & perceived mental healthcare need in Indian population during COVID-19 pandemic, Asian J. Psychiatr. 51 (2020) 102083, https://doi.org/10.1016/j.ajp.2020.102083.

[8] D. Kumari. Nutrition is important for boosting the immunity and it plays a significant role in preventing COVID 19, J. Nutraceuticals Food Sci. 5 (2020). www.imedpub.com.

[9] M. Hamid, M. Rahman, S. Ahmed, K. Hossain, Status of poultry industry in Bangladesh and the role of private sector for its development, Asian J. Poultry Sci. 11 (2017) 1–13, https://doi.org/10.3923/ajpsaj.2017.1.13.

[10] M.S. Rahman, G.C. Das, Effect of COVID-19 on the livestock sector in Bangladesh and recommendations, J. Agric. Food Res. 4 (2021) 100128, https://doi.org/10.1016/j.jafar.2021.100128.

[11] WPSA-BB, WPSA-BB, World’s Poultry Science Association Bangladesh Branch, Poul. Bangladesh Key Facts Fig, 2021. https://wpsa-bb.com/poultry-at-a-glance/.

[12] E. Heger, L.A. Odetokun, O. Bolariwu, A. Zainab, O. Okechukwu, A.I. Al-Mustapha, Knowledge, attitude, and perceptions towards the 2019 Coronavirus Pandemic: a bi-national survey in Africa, PLoS One 15 (2020), e0236918, https://doi.org/10.1371/journal.pone.0236918.

[13] M.M. Meher, J. Islam, M. Afrin, Investigation of risk factors and biosecurity measures associated with prevalence of newcastle disease virus in broiler farms, Turkish J. Agric. - Food Sci. Technol. 8 (2020) 2426–2432, https://doi.org/10.24925/turjaf.v8i11.2426-2432.3710.

[14] M.Z. Ferdous, M.S. Islam, M.T. Sikder, A.S.M. Mosaddek, J.A. Zegarra-Valdivia, D. Gozal, Knowledge, attitude, and practice regarding COVID-19 outbreak in Bangladesh: an onlinebased cross-sectional study, PLoS One 15 (2020) 1–17, https://doi.org/10.1371/journal.pone.0239254.

[15] A. Hocking, C. Laurence, M. Lorimer, Patients’ knowledge of their chronic disease: the influence of socio-demographic characteristics, Aust. Fam. Physician 42 (2013) 411–416. https://pubmed.ncbi.nlm.nih.gov/23781550/ (accessed March 21, 2021).

[16] M.A. Hossain, M.I.K. Jabid, K.M. Amman Hossain, L.M. Walton, Z. Uddin, M. O. Haque, M.F. Kabir, S.M. Yasir Arafat, M. Sakol, R. Faruqui, Z. Hossain, Knowledge attitudes and fear of COVID-19 during the rapid rise period in Bangladesh, PLoS One 15 (2020) 1–13, https://doi.org/10.1371/journal.pone.0239646.

[17] R. Banik, M. Rahman, M.T. Sikder, Q.M. Rahman, M.U.R. Pranta, Knowledge, attitudes, and practices related to the COVID-19 pandemic among Bangladeshi youth: a web-based cross-sectional analysis, J. Public Health (2021) 1–15, https://doi.org/10.1016/j.puhe.2020.05.032.

[18] R. Mahmad, COVID-19 and the Future for Bangladesh’s Poultry Sector, Dily. People’s Time, 2020. https://www.dailypeoplesetime.com/details.php?id=716&fbclid=IwAR0s2_o7fF08qhw-CNpWZYf07-iQMsX_E3cEulubacTKZ1Y5dhjq5IVDEP0k.

[19] D.L. Suarez, M.J. Pantin-Jackwood, D.E. Swayne, S.W. Ayers, S.W. Lefrancois, E. Spackman, Lack of susceptibility to SARS-CoV-2 and MERS-CoV in poultry, Emerg. Infect. Dis. 26 (2020) 3074–3076, https://doi.org/10.3201/eid2612.200289.

[20] J. Shi, Z. Wen, G. Zhong, H. Yang, C. Wang, B. Huang, R. Liu, X. He, L. Shuai, Z. Chen, Z. Bu, Susceptibility of ferrets, cats, dogs, and other domesticated animals to SARS coronavirus 2, Science 368 (2020) 1016–1020, https://doi.org/10.1126/science.aba7015, 80.

[21] G. Huynh, T.H. Nguyen, V. Tran, K. Vo, V. Vo, L. Pham, Knowledge and attitude toward COVID-19 among healthcare workers at district 2 hospital, Ho chi minh city, Asian Pac. J. Trop. Med. 13 (2020) 260, https://doi.org/10.4103/1995-7645.280396.