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Original Research

Sero-Prevalence and Risk Factors for Infectious Bursal Disease in Local Chicken on Backyard Production System in Selected Districts of Ilubabor Zone, South Western Ethiopia

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ABSTRACT

Introduction
Gumboro is an acute, highly contagious, and immunosuppressive viral disease of young chickens less than 17-weeks. However, in local chicken flocks of Ilubabor, there is no known sero-status of the disease.

Methods
To address this information gap, a cross-sectional study was conducted in local backyard chicken flocks of three districts of Ilubabor Zone where chick mortality and morbidity were a big problem. The objectives of the study were to estimate the seroprevalence of infectious bursal disease virus (IBDV) and to assess its risk factors.

Result
Out of 418 serum samples tested, 180 were positive and the overall chicken level seroprevalence of the IBDV antibody in the study area was found to be 43.10% (95% CI: 38.40-47.85) and flock-level seroprevalence was 45.63% (73/160) (95%CI: 37.91-53.34) with almost all test positive flock chickens were seropositive. Multivariable analysis at chicken level showed that the odds of IBDV seroprevalence was significantly high in Metu and Bilo Nopa districts, in purchased, in female and adult chickens. Also, it was high at flock level in chickens mixed with exotic breeds, in flocks having greater than 5 chickens.

Conclusion
This study shows that IBDV is circulating in the chicken population of Ilubabor at a high prevalence level. Therefore, further studies on serotypes and strains of IBDV identification should be carried out to design suitable control and prevention measures.

Keywords
Cross-sectional; Ethiopia; Backyard chickens; IBDV; Risk factors; Seroprevalence.

INTRODUCTION

Livestock production offers concerning forty-seven per cent of the agricultural gross domestic product and 18% of the national gross domestic product of Federal Democratic Republic of Ethiopia.[1] Chicken production is an important and essential part of most Ethiopian households in rural, urban, and peri-urban areas. Poultry will play a key role in managing financial crisis and food security. Moreover, as chicken farming is often done by ladies and youngsters, this will play a key role in unit labor productivity and gender authorization.[2] Ethiopian Ministry of Agriculture has recognized chicken production as a key sector to upset food security problems. The intention is to lift the number of meat and eggs created annually by increasing the amount of poultry farms and introduction of improved breeds.[3]

The backyard chicken production system that accounts for 96% of Ethiopia's fifty million chicken populations.[4] It is extremely poor, as scavenging chickens live along side individuals and different species of farm animals. In the backyard chicken production system, no way that of dominant movement and dropping of chickens, since chickens freely rove within the unit compound. Iso-

lation of sick chickens from the flocks and dead chicken disposal has not been practiced.[2] Around 40-60% of the chicks hatched die at the 1st eight weeks of life[5,6] that predominantly because of disease and predation. Moreover, Alamargot[7] recorded a death rate of 20-50% in indigenous chickens due to disease. Since village backyard chickens habitually exposed to overwhelming numbers of microorganisms, infectious bursal disease virus is one amongst the diseases that cause chick mortality.[8] Infectious diseases like Newcastle disease and infectious bursal disease are reported to be the key health and production constraints of chickens.[9]

The infectious bursal disease is also known as Gumboro disease, an acute, highly contagious, and immunosuppressive[10,11] viral disease affecting mostly young chicks. The causal virus belongs to the genus Avibirnavirus of the family Birnaviridae. Two serotypes of the virus are identified. Serotype one virus is infective to chickens. Sero type two virus is nonpathogenic to chickens and has been isolated from each chickens and Turkeys.[12] It constrains poultry industries worldwide.[13] It causes appreciable economic losses ensuing from mortality[14-16] and an immunological disorder that ends up in vaccine failure against different infectious diseases.[17] Additionally, the immunological disorder will increase the status of chickens to different infectious diseases.[11] Maternal antibodies to infectious bursal disease (IBD) in susceptible chickens act chicks up to twenty-one-days.[18]

Large losses are a result of opportunist infections encountered by poultry farmers and particularly the crisis in developing countries like Ethiopia.[19] IBD is an extremely communicable disease of young chickens (<17-weeks of age) during which the tissues of the system, and particularly the bursa of Fabricius, are targeted leading to immunological disorders and prone for different infections, such as *E. coli*, Salmonella, Mycoplasma, coccidia, Marek's disease and others.[20] The disease is unfolded through contaminated feed and water.[21] In chickens, severe acute disease, typically in three to six-week-old birds, is related to high mortality, however less acute or subclinical infections are common earlier in life.[22]

In Ethiopia, IBD incidence was occur in 2002 for the 1st time at a personal business poultry farm with a death rate of 45-50% and therefore the incidence of recent strains of IBD became a challenge to the juvenile poultry business in Ethiopia.[23] The first study on the incidence of IBD in Ethiopian village poultry was in 2 areas within the Amhara region that had received "improved" chicks from an advertisement farm,[24] and it has been advised that this was the explanation for the introduction of the disease to village poultry.

The seroprevalence of IBD in backyard chickens was studied in numerous components of Ethiopia. Among these: thirty-nine in East Shoa Zone, Oromia,[25] 38.4% in 2 districts of Amhara region, Northwest Ethiopia[26]; 76.64% in Waliso, Ambo, and Welmera[27], 29.4% in Bahir dar[24], 83.1% in selected sites of Ethiopia[28], 72.7% prevalence in Gondor[29], 45.05% around Mekele town North Ethiopia,[30] 51.56% in and around Bahir Dar North West Ethiopia,[31] 84.2% in North Shoa Zone of Oromia and Amhara region[32,33] 20.7% and 51.7% In Jigjiga and Harrar, East Ethiopia.[34]

Due to happening reports of chickens, disease mortality and morbidity in the Iluababora zone in 2020, questionnaire survey was done by Bedelle Regional Veterinary Laboratory Center to assess chickens' disease and issues. Chick mortality and morbidity were the foremost outstanding issues and IBD was one amongst the diseases assessed throughout the farm survey. However, there was no study on seroprevalence and associated risk factors of infectious bursal in native grounds chicken production during this zone. Therefore, this study was required to be a remedy to chick mortality and morbidity within the study areas with the following objectives.

- To estimate the seroprevalence of infectious bursal disease virus (IBDV) among native chickens in backyard production systems of Hurumu, Metu and Bilo Nopa districts of Ilubabor Zone.
- To assess risk factors for the incidence of IBDV in local chickens of backyard chicken production systems of Hurumu, Metu and Bilo Nopa districts of Ilubabor Zone.

MATERIALS AND METHODS

Description of Study Area

This study was conducted in three districts (Hurumu, Metu, and Bilo Nopa) of Ilubabor Zone of Oromia Regional State, Ethiopia. Ilubabor Zone is located in the South-Western part of Ethiopia, 600 kms away from Addis Ababa (Figure 1). Hurumu district is located at a latitude of 08°21'42" to 08°31'17" North and 35°05'18" to 35°68'30" East. It comprises 48,395 cattle, 20,938 shoots, 4686 equine, 50,559 local chickens, and 13,834 exotic Sasso T-44 and Bovans Brown chicken breeds. There were 6 small-scale poultry farm microenterprises and 2 private small-scale poultry farms in Hurumu district (Hurumu District Livestock Resource and Development Office, 2021).

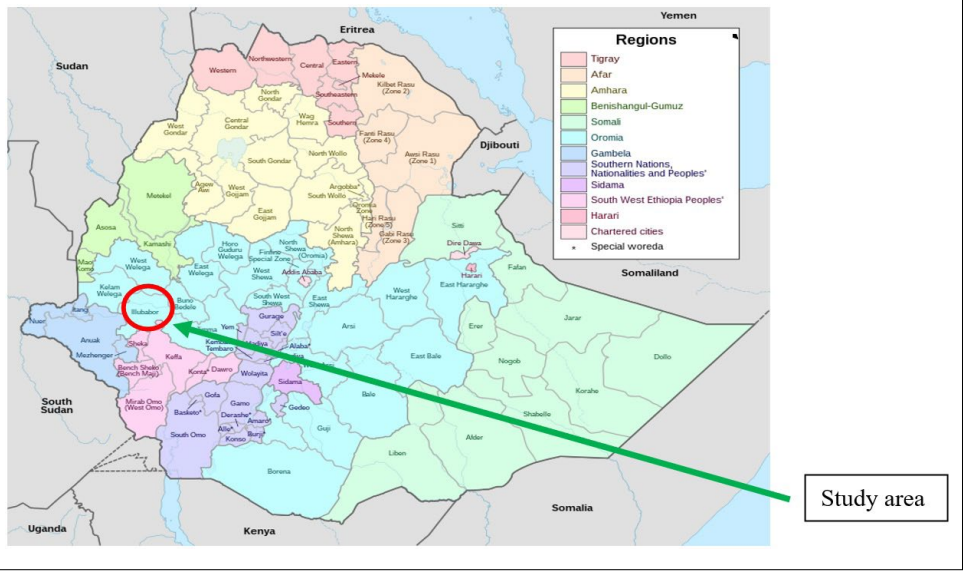
Metu district is located at longitude 035°.32' to 040°.29' East and latitude 08°.28' to 010°.54' North of the equator. The livestock population of the Mettu district comprises of 146,635 cattle, 93,012 shoats, 24,372 equines, 134,132 local, and 57,260 exotic Sasso T44 and Bovans Brown chicken breeds. There were 17 small-scale poultry farm microenterprises and 8 private small-scale poultry farms in Metu district (Metu District Livestock Resource and Development Office, 2021).

Bilo Nopa district is located at latitude of the area ranging from 07°05.33' to 08°45.33' to North while the longitude of the area ranges from 033°47.57' to 036°52.33' East. This district comprises a livestock population of 17,289 cattle, 12,614 shoats, 850 equines, 24,550 local chickens, and 7,440 exotic SASO T-44 and Bovans Brown chicken breeds. There were 7 small-scale poultry farm microenterprises and 3 private small-scale poultry farms in Bilo Nopa district (Bilo Nopa District Livestock Resource and Development Office, 2021).

Study Methods

The study was conducted in local chickens raised under the backyard production system of three districts. Most of them were scav-

Figure 1. *Map of Study Areas (Ilubabor Zone Livestock Resource Development Office, 2021)*



enging chickens living together with people and other species of livestock. The chicken movement was unlimited and free-roaming in the household compound. There was no practice of isolating sick chickens from the flocks. The total population of chickens from 160 households were 822, including none sampled chicks less than 3-weeks, and the average flock size was 5.14(822/160) chickens per household, while 6.23(467/75), 4.49(206/46), and 3.82(149/39) average flock density in Metu, Bilo Nopa, and Hurumu districts, respectively.

The breeds of chickens in the study area were Horo local breed and exotic Sasso T-44 and Bovans Brown breeds.[35] More than half of the households bought exotic chicken breeds and they scavenge with local breeds of grain, common maize supplement. Most farmers buy exotic chickens from multiplication centers through the livestock sector while few of them buy from small-scale poultry farm microenterprises and open markets. Exotic breeds had been believed as they were vaccinated against IBD before distribution to farmers, thus that was why samples were only collected from the local chicken breed. Chickens were categorized by age young (<17-weeks) and adult ≥17-weeks) based on the clinical characteristics of IBD disease.[20] Chicken flocks were categorized based on chicken numbers greater than five (>5) and less than or equal to five (≤5), which was based on the average number of chickens per flock (5.14) per household in the study area.

Study Design

The study was cross-sectional from March 2021 to August 2021. Data to assess risk factors related to IBDV were collected using a questionnaire survey and serum sample collection format. In all studies kebele's, selected poultry owners were interviewed face to face during blood sample collection. Variables included in the survey were study area, age (young, adult), sex, cleaning activity of the housing area (regular or daily, irregular or not fixed), flocks mixed with exotic chicken breed (yes, no), number of chickens per flock, source of chickens (home breed, purchased) and flocks housing system (separated house, roost in family dwelling or kitchen) were emphasized as risk factors.

Sample Size Determination and Sampling Technique

The sample size was determined according to sequential multiple assignment randomized trial (SMART) methodology[36] using cluster random sampling using an expected animal level prevalence of 50% and a desired absolute precision of 5% with 95% CI, since there was no previously expected prevalence in the study area.

$$n=\frac{t^2\times p\times q}{d^2}\times DEFF$$

$$n=\frac{(2.045)^2\times 0.5\times 0.5}{(0.05)^2}\times 1=418$$

Where, n=sample size, t=linked to 95% confidence interval for cluster sampling (2.045), p=expected prevalence (fraction of 1), q=1-p(expected prevalence), d=relative desired precision, DEFF=Design Effect=1.

Accordingly, 418 local backyard chickens were sampled. First, districts were purposively selected based on chicken disease outbreak reports and a questionnaire survey done on backyard chicken mortality and morbidity. Metu, Bilo, Napa, and Hurumu districts have 29, 15, and 14 kebele's, respectively. Based on the chicken's population and the number of kebele lists from each district; 5 kebeles from Metu district, 3 kebeles from Hurumu, and 3 kebeles from Bilo Nopa district were randomly selected by lottery method. At the 2nd stage, the household of each kebele was randomly selected. Finally, except chicks below 3-weeks, all chickens were sampled.

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Sample Collection and Transportation

Blood samples were collected aseptically from the wing vein victimization 3 ml disposable syringe. The syringe was placed in an exceedingly slope position for long at room temperature to empty the sera samples. The separated serum was transferred into a sterile cryovials tube, labeled, and transported to Bedelle Regional Veterinary Laboratory Center underneath a cold chain for laboratory analysis. The sera were kept at -20 °C until the check were performed. Indirect enzyme-linked immunosorbent serologic assay was sent to discover IBD virus antibodies employing a commercially ready IBDV enzyme-linked immunosorbent serologic assay check kit. Individual-level connected risk factors: sex, age, and supply of chickens.

Serological Test and Laboratory Analysis

Innovative diagnostic indirect enzyme-linked immunosorbent serologic assay kit (Louis Pasteure Grabels, France) discovered the presence of anti-IBD antibodies within the chicken serum following the kit manufacturers' suggested protocol. The test sera were pre-diluted by dilution buffer 14 in a pre-dilution plate according to the established protocol or kit instructions, and each was dispensed into the requested number of micro wells. In the ELISA plate pre-diluted samples and dilution buffer 14 were added and incubated for 30 min±3 min at 21 °C. After incubation, the sera were discarded from the plates, and each well was washed 3 times by 300 µl of washing solution. About 100 µl anti-chicken immunoglobulins peroxidase conjugate was dispensed into the wells and the plates were incubated for 30±3 min at 21 °C. After incubation, again the sera were discarded from the plates, and each well was washed 3 times by 300 µl of washing solution. About 100 µl substrate solutions were dispensed into each test well and again incubated for 15±2 min at 21 °C in the dark place. After a final incubation, the substrate chromogen reaction was stopped by adding about 100 µl stop solution and the color reactions were quantified by measuring the optical density of each well at 450 nm.

To ascertain the validity of IBD enzyme-linked immunosorbent serologic assay results, a validity check was done. In the valid IBD enzyme-linked immunosorbent serologic assay results, the mean optical density (OD) price of positive management humor is bigger than (0.25), and the quantitative relation of the mean of the positive and negative management (OD_{PC} and OD_{NC}) is bigger than three. For the interpretation of the results, a humor sample positive (SP) management quantitative relation was needed. Consequently, the sample positive quantitative relation was calculated as follows. If S/P price was >(0.3), the IBD protein standing was thought of to be positive, however, <(0.3) was taken as negative.

$$\frac{S}{P}\% = \frac{OD_{sample} - OD_{NC}}{OD_{PC} - OD_{NC}}$$

Data Management and Analysis

All data obtained from the field was recorded in the record sheet format and later entered into Microsoft Excel worksheet and binary logistic regression for flock level data and multilevel mixed-effects model (Generalized Leaner Model logit) for chicken level data statistics was used to summarize the data by using stata software version 13. The overall prevalence was calculated by dividing positive samples by the total number of examined samples and multiplied by a hundred. Seroprevalence was categorized into chicken level (sex, age, source, study area) and flock level (study areas, cleaning activity, presence of exotic breeds within the flock, number of chickens per flock and housing system of chickens).

Multivariate logistic regression analysis was used to examine the relationship between the outcome variable (seroprevalence) and the different explanatory variables controlling the possible effect of confounders. The odds ratio (OR) was used to assess the association between the dependent and independent variables. *p*-value of less than 0.05 ($p<0.05$) was set for the significance of statistical associations.[37]

RESULTS

Overall Seroprevalence of IBDV Antibody

Among the 418 chicken serum samples tested for IBDV antibodies to know chicken level IBD infection, 180 samples were positive for IBDV antibody with an overall seroprevalence of 43.10% (95%CI: 38.40, 47.85) in the study area.

District and Village Level Chicken Seroprevalence of IBDV Antibody

The highest chicken level seroprevalence of IBDV was observed in the Metu district (100/194, 51.55%) followed by the Bilo Nopa district (45/125, 36%) and Hurumu district (35/99, 35.35%). The seroprevalence of IBDV was higher in purchased chickens (64.23%) than home breed chickens (32.74%), in females (48%) than males (31.45%), and in adults (54%) than in young chickens (31.71%) as illustrated in (Table 1).

Table 1. *Chicken Level Seroprevalence of IBDV Antibodies (district, age, sex, and source)*

Risk Factors	Category	No. Tested	Positive	P (95% CI)
Districts	Metu	194	100	51.55 (44.55-58.48)
	Bilo Nopa	125	45	36 (28.12- 44.72)
	Hurumu	99	35	35.35 (26.64-45.16)
Sex	Female	294	141	48 (42.31-53.66)
	Male	124	39	31.45 (23.94-40.08)
Age	Adult	213	115	54 (47.29-60.55)
	Young	205	65	31.71 (25.72-38.36)
Chicken source	Purchased	137	88	64.23 (55.92-71.77)
	Home breed	281	92	32.74 (27.52-38.43)

P=Prevalence, CI=Confidence interval

Flock Level Seroprevalence of IBDV Antibody

Out of 160 flocks tested for IBDV, 73 flocks were found positive for IBDV antibody and flock level seroprevalence of IBDV was 45.63% (95%CI: 37.91, 53.34%). On average, 3 serum samples (480/160=3) were collected per flock and 2.8 chickens per flock

(180/73=2.5) were positive for the IBDV antibody, which indicated almost all positive flock chickens were seropositive. The highest flock level seroprevalence of IBDV was observed in Metu district (38/75, 50.66%), followed by Bilo Nopa district (20/46, 43.48%) and Hurumu district (15/39, 38.46%). The seroprevalence of IBDV was higher in flocks mixed with exotic chickens (66%) than those not mixed (20%), in flocks greater than five (>5) 60% than in flocks less than or equal to five (≤5) 31%, in an irregularly cleaned house of flocks 49% than a regularly cleaned house of flocks 38% and roost in family dwelling 46% than separated housing 44% chickens as illustrated in (Table 2).

Table 2. *Flock Level Seroprevalence of IBDV Antibody*

Risk Factors	Category	No. Tested	Positive	P (95% CI)
Districts	Metu	75	38	50.66 (38.86-62.42)
	Bilo Nopa	46	20	43.48 (30.21-57.75)
	Hurumu	39	15	38.46 (23.36-55.38)
Number of chickens	>5	82	49	60 (48.34-70.44)
	≤5	78	24	31 (20.81-42.24)
Presence of exotic chicken breed	Yes	89	59	66 (55.49-75.97)
	No	71	14	20 (11.22-30.86)
Cleaning activity	Irregular	110	54	49 (39.43-58.80)
	Regular	50	19	38 (24.65-52.83)
Chickens housing	Roost in family dwelling	110	51	46 (37.33-55.65)
	Separated house	50	22	44 (29.99-58.75)

P=Prevalence, CI=Confidence interval

Chicken level Risk Factors Associated with Inflammatory Bowel Disease

In multivariate logistic regression analysis, sources of chicken (p=0.000), study area (Metu p=0.000, Bilo Nopa p=0.023), sex (p=0.001) and age (p=0.017) were independent predictors of IBD infection. The odds of IBD seroprevalence was more likely higher in females than males, in adult than young, in purchased than home breed, in Metu and Bilo Nopa districts compared to Hurumu district (Table 3).

Table 3. *Chicken Level Risk Factors were Analyzed by Multivariate Logistic Regression*

Risk Factors	Category	No. Tested	Positive (%)	Multivariate	
				AOR (95% CI)	p value
Study area	Metu district	226	117 (51.77)	2.52 (1.58-4.02)	0.000
	Bilo Nopa	107	40 (37.4)	1.81 (1.08-3.05)	0.023
	Hurumu	147	50 (34)	RF	
Chicken source	Purchased	158	102 (64.50)	3.58 (2.60-4.93)	0.000
	Home breed	322	105 (32.60)	RF	
Sex	Female	339	163 (48)	2.25 (1.38-3.67)	0.001
	Male	141	44 (31.20)	RF	
Age	Adult	255	137 (53.7)	1.95 (1.13-3.36)	0.017
	Young	225	70 (31.10)	RF	

P=Prevalence, CI=Confidence interval, RF=Reference factor

Flock level Risk Factors Associated with IBD

In multivariate logistic regression analysis, the presence of an exotic breeds within the flock (p=0.000), the number of chickens per flock (p=0.004) were independent predictors of IBD infection. The odds of IBD seroprevalence were more likely higher in flocks mixed with exotic chickens than flocks who did not mix with exotic breeds and in larger flock sizes (greater than five chickens) than smaller flock sizes as shown in (Table 4).

Table 4. *Flock Level Risk Factors were Analyzed by Multivariate Logistic Regression*

Risk Factors	Category	No. Tested	Positive (%)	Multivariate	p value
Presence of exotic chicken breed	Yes	89	59	5.02 (2.24-11.27)	0.000
	No	71	14	RF	
Number of chickens	>5	82	49	3.17 (1.43-6.90)	0.004
	≤5	78	24	RF	

AOR=Adjusted odds ratio, CI=Confidence interval, RF=Reference factor

DISCUSSION

There has been increasing interest to estimate the prevalence of IBD in the local backyard chicken production systems since 40-60% of the chicks hatched die during the first 8-weeks of life[5,6] mainly due to disease and predation. The current finding has a role in the reduction of chicken mortality and morbidity, ensuring improved chicken production and productivity by generating real-time epidemiological information to the poultry sector.

The overall seroprevalence of IBDV in the local chickens of backyard production system in the present study was 43.13% (CI: 38.69, 47.56). The overall seroprevalence of IBDV in this study is in line with the study done in India, 46.2% by Singh et al[38], 45% in Taiwan[39], and around Mekelle town, Northern Ethiopia 45.05% by Zegeye et al.[30] In contrast, the overall seroprevalence of IBDV in local chickens of backyard production system in this study was higher than the reports of 33.9% in Cameroon[40,41] 30.7% in Sudan,[42] 30% in Bostwana,[25] 39.2% in East Shoa zone, Oromia region Ethiopia,[26] 38.4% in two districts of Amhara region, Northwest Ethiopia,[24] 29.4% in two districts of Amhara region Ethiopia,[43] 7.26% in Nigeria at Zuria,[33] 20.7% in Eastern Shewa Zone Oromia region Ethiopia[44] and 33.4% in Nigeria.

However, the current prevalence is lower than the previous studies[27-29,31,32,34,45,46] reported elsewhere with the prevalence of 76.64%, 83.1%, 73.5%, 63.5%, 82.2%, 51.56%, 84.2%, 51.7%, respectively in different parts of Ethiopia in backyard chickens production system. Moreover, in other African countries, the overall seroprevalence of IBD in the backyard chicken production system in this study was lower than and who reported an overall prevalence of 55% from Zimbabwe[40,47] and 60% from Nigeria, respectively. The current seroprevalence difference with different studies done before in different parts of Ethiopia may be due to less distribution of exotic chicken breeds among backyard chickens than in comparison to other zones, the test kit we used was with 100%

sensitivity and specificity, study area far (600 km) away from the central part of Ethiopia where the chicken intensification more practiced that in agreement with Zeleke et al[9,48] who investigated IBDV being introduced and disseminated into Ethiopia through exotic chicken breeds, the lower human population in comparison to other study areas, there have been lower chicken product demand consumption and lower purchase of live chickens in the open market which was one of the risk factors responsible for the spread of IBDV.[49]

The odds of IBDV seroprevalence was 2.52 (95% CI: 1.58-4.04, p=0.000) and 1.81 (95% CI: 1.08-3.05, p=0.023) times higher more likely in chickens in Metu and Bilo Nopa districts, respectively in compare to Hurumu district. This finding was in agreement with the findings of different researchers[27,30,32,34,46,50] that showed a significant association of IBDV seroprevalence between different study areas. In contrast, studies conducted by researchers[51] and reported that no variation was found in the seroprevalence of infectious bursal disease in different study areas.[29] The higher seroprevalence of IBDV in Metu and Bilo Nopa districts as compared to Hurumu district in the present study could be due to larger average flock density per household, larger exotic chicken breeds distributed to farmers, and larger small-scale poultry farm enterprises in Metu and Bilo Nopa in compare to Hurumu that agree with previous reports of Farooq et al[52] who showed overcrowding increase transmission of disease and previous reports of Zeleke et al[9], Zeleke et al[48] who showed introduction and dissemination of IBDV in Ethiopia through exotic chicken breed importation and distribution to farmers.

The seroprevalence of IBDV was higher in purchased chickens (64.50%) than home breed chickens (32.60%). The odds of IBDV seroprevalence was 3.58 (95% CI: 2.60-4.93, p=0.000) times higher more likely in chickens purchased than those breeds at home. This result was in agreement with Rashid et al[49], Swai et al[50] that showed that the purchase of live poultry from an open market is the main risk factor for IBDV dissemination. In the current study, the higher seroprevalence in purchased chickens than home breed could be due to contact of hundreds of chickens at local open-air markets from different farmers, villages, towns, kebeles, districts, and zones especially during the ceremony which were then taken back to different localities that certainly facilitate the spread of IBDV among backyard chickens.

The seroprevalence of IBDV was higher in females (48%) than males (31.20%). The odds of IBD seroprevalence were 2.25 (95% CI: 1.34-3.67, p=0.001) times higher more likely in females than males. This finding is in agreement with a report from Zegeye et al,[30] who reported 54.18% of females and 27.82% of males. The significant association observed between sex and IBD infection might be because sexual maturity in females corresponds with a reduction in T-lymphocyte numbers leading to suppression of cellular immunity, so the reproductive demands placed on females may raise the pathogen load of frequently encountered infections.[53] In contrast to current study, reports from[29,32-34,46,50] showed that there was no significant association of seroprevalence between sexes.

The seroprevalence of IBDV was higher in adults (53.70%) than in young chickens (31.10%). The odds of IBDV seroprevalence was 1.95 (95% CI: 1.13-3.36, p=0.017) times higher more likely in adult chickens than young chickens which are similar to the studies[30,32,54] of that reported an increased seroprevalence of IBD infection as the age of chickens increase. Contrary to this finding reported by Lemma et al,[34] seroprevalence of IBD was not significantly associated with age. The production of backyard chickens of different age groups together might make the infection within a given flock increase exposure as suggested by Nawathe et al.[55] The significant association of IBD infection with age in the current study might be because adult chickens need enough time and space for scavenging in their surroundings and ingest more contaminated feed by microorganisms while, chicks below six-weeks of age confined in the house.[56]

In this study, flocks mixed with exotic chickens and those who had not were compared and a higher seroprevalence of (66%) in flock mixed with exotic chickens than those not mixed (20%) with exotic chickens. The odds of IBDV seroprevalence were 5.02 (95% CI: 2.24-11.27, p=0.000) times more likely in flocks mixed with exotic chicken breeds compared to those that did not mixed. The current study agrees with studies[9,48] who investigated IBDV was introduced and disseminated in Ethiopia *via* exotic chicken breeds. According to the report of this author, Ethiopia has been known to be free from IBD[57] until its first occurrence in 2002. It also, in agreement with Mazengia et al[24] who suggested that the first study on the incidence of IBD in Ethiopian village poultry was due to the distribution of "improved" chicks from a commercial farm to farmers. The significant variation of IBDV seroprevalence noted between flocks mixed with exotic chicken breeds and to none mixed backyard flocks could be related to the dissemination of IBD virus through the distribution of improved breeds of chickens from infected poultry breeding and multiplication centers to backyard village chickens.

Flock size had a significant effect on the seroprevalence of IBD in the study area when multivariable logistic regression analysis was carried out. The highest prevalence of IBD antibody was recorded in flocks with chicken numbers greater than five (>5) 60% than in flocks with chicken numbers less than or equal to five (≤5) 31%. The odds of IBDV seroprevalence were 3.17 (95% CI: 1.43-6.90, p=0.004) times higher more likely in larger flock size than that of smaller flock size less than or equal to 5. This result was in agreement with Jarso, 2016 who reported higher odds of IBD infection in larger flock size than smaller flock size. In the current study, the higher seroprevalence in larger flock size could be due to no supplementary feed in backyard chicken under backyard chicken production systems, and there is higher feed competition in larger flocks as a result chickens need to scavenge for a longer time for survival and routinely exposed to IBD virus.

CONCLUSION

The current study indicates that the seroprevalence of IBDV is high and the IBD virus was found circulating in study sites which may cause economic losses in the poultry sector. Furthermore, the present study demonstrated that the seroprevalence of infectious bursal disease virus in local chickens of the backyard production

system was influenced by the study area, source of chicken, sex, age, presence of exotic breeds within the flock, and number of chickens per flock. This seroprevalence might be due to field exposure of chickens to the disease and indicates the importance of further study on the serotype and strains of IBDV that are circulating in the study sites to design appropriate control and prevention measures.

DATA AVAILABILITY

All data used during analysis of this research to support the findings of this research are included within the article.

DISCLOSURE

The research was performed at Bedele Regional Veterinary Laboratory center, Ethiopia.

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ETHICS APPROVAL AND CONSENT TO PARTICIPATE

A local ethics committee ruled that no official ethics approval was required to carry out this study since it was only blood collection. Before conducting the study, informed permission was obtained from the owners of the chickens used in this study.

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