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Review Article

Prevalence of Poultry Coccidiosis and Its Determinants in Small Scale Poultry Farming System Around Arba Minch Town, Southern Ethiopia

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Keywords

- *Eimeria* Species
- Poultry
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Abstract

Despite the presence of a large number of chickens in Ethiopia, contribution to the national economy and benefit from this sector is very limited due to disease problems. Cross sectional study was conducted on two exotic breeds, *Sasso* T44 and *bovans* brown, from September 2023 to April 2023 in and around *Arba* Minch town, southern Ethiopia. The objectives of this study were to estimate the prevalence of coccidiosis, to identify species of *Eimeria* and to assess potential risk factors. The study involved fecal floatation techniques, postmortem examination of chickens' intestines for gross lesions and mucosal scraping to determine predilection site and identification of *Eimeria* species. Two stage cluster sampling technique was used to sample the study chickens and the data was *analysed* by using *univariable* and *mutivariale* logistic regression. An overall of 1004 examined chickens, 219(21.81%) were harbored different *Eimeria* species. In the current study, statistically significant differences ($p<0.05$) were observed in clinical status of the chickens, prophylaxis provision, litter moisture and water sources. The five *Eimeria* species identified were E. *tenella*, E. *necatrix*, E. maxima, E. *burnetti* and E. *acervulina* with the proportion of 37.44%, 18.72%, 16.44%, 15.53% and 11.87%, respectively. Postmortem examination was carried out on 24 chicken, out of which 19 (79.17%) were positive to coccidiosis by mucosal scraping examination and pathological lesions were observed on the different parts of small intestine and caecum. In conclusion, the present study showed that coccidiosis is an important disease of poultry in the study area and strict sanitary and preventive measures needed to be implemented to reduce the loss due to poultry coccidiosis.

ABBREVIATIONS

AMU: *Arba* Minch University; CSA: Central Statistical Authority; FAO: Food and Agricultural Organization; KPMRC: *Kombolcha* poultry multiplication and research center; PCR: Polymerase chain reaction

INTRODUCTION

Background

According to the Food and Agriculture Organization [1], the global chicken population has reached an astounding 26 billion, 75% of which are in developing countries [2]. Poultry farming is a significant source of revenue generation and food for small farmers in developing countries. Female farmers mostly take responsibility for poultry production in rural communities. In many parts of the modern world, poultry is regarded as the primary source of not only low-cost animal protein but also high-quality human food [3].

An estimate shows that the country is home to about 57.01 million poultry. By these numbers, poultry is ranked second next to cattle. The Ethiopian poultry population is almost entirely composed of indigenous chickens. Recent estimates showed that 78.85%, 12.02%, and 9.11% are indigenous, hybrids, and exotic poultry, respectively [4].

So far, three types of poultry production systems have been identified for managing these poultry populations. Backyard poultry production systems, small-scale intensive poultry production systems, and large-scale intensive poultry production systems are examples of poultry production systems in Ethiopia. In all production systems, chickens are raised to produce eggs and meat for income and domestic consumption [5]. Furthermore, 99% of the chicken population is raised using the traditional back yard management system, while 1% is raised using the intensive management system. Traditional production system is characterized by minimum inputs; chickens gather food, receive simple housing like sharing house with their owners at night, and breed naturally which leads to low output from the production [6].

Diseases, predation, starvation, inadequate housing, and poor management system all hinder Ethiopia's chicken production systems. Newcastle disease, coccidiosis, salmonellosis, chronic respiratory disease, and nutritional deficiencies are the most prevalent illnesses affecting chickens in Ethiopia. The mortality rate from these diseases in chickens is thought to be between 20 and 50 percent, but during epidemics, it can reach 80 percent [7]. Among those diseases, coccidiosis is economically important and prevalent in chicken farms in Ethiopia [6].

Coccidiosis is the commonly encountered and economically important disease adversely affecting poultry production and its prevalence and economic significance have been reviewed by different scholars in different production systems in Ethiopia [8]. Poultry production are becoming more intensified which give greater chance to direct contact with their feces in a moist environment from deep litter system in flooring that ensures survival of the oocysts and their transmission from flock to flock [9].

Poultry coccidiosis is caused by single-celled protozoan parasites of the genus *Eimeria* and has nine species. Most common and pathogenic species that affect the poultry is *Emeria tenella,* resulting in 100% morbidity and a high mortality [10]. In Ethiopia, E. *acervulina*, E. *necatrix*, E. maxima, and E. *tenella* are endemic in all parts of the country and affect mainly young growing chickens [11].

Life cycle of all *Eimeria* species involves asexual (shizogony) and sexual phase (gametogony) which form oocyst [12,13]. Infection occurs by ingestion of sporulated oocyst, followed by the release of sporozoites in the duodenal lumen by mechanical and chemical action. Sporozoites invade the mucosa to start intracellular growth and asexual multiplication with periodic release of merozoites (develop to macro/male and micro/female gametes). Sexual phase occurs, fertilization of macrogamete by microgamete results in the formation of a zygote which is called as an oocyst [12,13]. The life cycle is rapid and may result in hundreds of thousands or even millions of oocysts produced from a single oocyst within 4 to 5 days [6].

Poultry coccidiosis distresses chickens in both clinical and sub-clinical forms. The clinical form of the disease is manifested by noticeable signs of mortality, morbidity, diarrhea or bloody feces, dehydration, lowered feed intake, weight loss, paleness, huddling, ruffled feathers, and depression [7]. The chicken affected with coccidia become tired and weak, young chickens often have blood in the faces after 4-5 days, later their eyes are closed and their wings hang down and many chickens die [14]. The occurrence of clinical coccidiosis is directly related to the number of sporulated oocysts ingested by a chicken at one time, the pathogenicity of the *Eimeria* species, the age of the infected chicken and the management system. Chickens suffering from coccidiosis quickly become less productive and poor performers. Laying hens will experience a reduction in rate of egg production [15]. The sub-clinical coccidiosis manifests mainly by poor weight gain and reduced efficiency of feed conversion and gives rise to the highest proportion of the total economic loss [16].

Poultry coccidian is strictly site specific and the different species parasitize specific parts of the intestine. Occurrence of coccidiosis is associated with different variables like host, agent, and environmental interaction. It is a ubiquitous disease of almost universal importance in poultry production. Identification of an oocyst in faces and postmortem assessment of intestinal lesions are the main strategies for the determination of coccidiosis in chicken [17]. Regardless of its significance of the diseases in Ethiopia, particularly in the study area, no substantial research was done.

Statement of the Problem

Poultry coccidiosis is endemic in Ethiopia and can cause great economic losses in the sector in all production systems mainly in intensive production systems [18]. Poultry coccidiosis is a problem which needs a deep and thorough investigation and subsequent monitoring so as to boost production and productivity. More knowledge of the etiology and population dynamics of coccidial infections in commercial poultry production is consequently needed [19]. In Ethiopia, with the increasing interest in poultry production evidenced by the proliferation of poultry farms, it is pertinent to continually evaluate the prevalence, frequencies of the different *Eimeria* species and management issues associated with common poultry diseases such as coccidiosis.

Poultry is the most important animal species in and around Arba Minch town both for nutritional value they contribute and cash income generation than other animals. Since they are the main resources especially for poor families. Due to national livestock development initiative and different entrepreneurial engagement in small scale poultry production in and around the town, Poultry raising system is now become more intensified than the past, this rapid growth of poultry production and low professional follow up which may leads to poor management system and rapid spread of poultry coccidiosis was the area of focus. Regardless of several researches have been done in different regions of Ethiopia (Safariet al. 2004), [20-

22], and the disease is still a major problem in Southern Ethiopia particularly in Gamo Zone and demanding much research and investigation.

Objectives

General Objective: To assess the epidemiology of poultry coccidiosis in and around arba minch town.

Specific objectives: To estimate the prevalence of poultry coccodiosis in and around Arba Minch town.

To identify the *Eimeria* species distribution in the study area.

To assess the associated risk factors related to poultry coccidiosis in the study area.

MATERIALS AND METHODS

Description of Study Area

The present study was conducted in and around Arba Minch town, Southern Ethiopia. Arba Minch town is the administrative center of Gamo zone, is bordered with Wolayta zone at the north, Lake Abaya and Chamo at the east, Segene and part of south Omo on the south. Arba Minch town is located about 505 km south of Addis Ababa. It lies near the center of the region around 5°57″–6°71″N latitude and 36°37''– 37°98″E longitude [23].

Arba Minch Zuria district is situated in the well-known area of East Africa rift valley and surrounded by Chamo and Abaya lakes as well as NechiSar national park. According to the report of Arba Minch Zuria district and Gamo zone livestock and fishery resource office (2024), the district has a total cattle population estimated to 106,709, sheep 28,706, goats 44,795, equine 3,364 and poultry 147,053. In Arba Minch town there are 48 poultry farms and in Arba Minch zuriya district there are about 17 poultry farms which are kept under intensive farming.

Study Population

The study animals included in the present study were Bovans Brown and Sasso T44 breeds of chickens from poultry farms owned by local farmers in and around the town. The study chickens were grouped into breeds (Brown Bovans and Sasso T44), and ages classified as young (chicks <6 weeks, young between 7-15 weeks and adult >16 weeks) based on Oljira et al., [24]. The study Chickens were kept under small scale intensive farming system.

Inclusion criteria: The kebeles and farms that have exotic breeds managed in small scale intensive production system with all age were included in the study.

Exclusion criteria: The kebeles having local breed and extensive management system are excluded from the study.

Study Design

A cross-sectional study design was conducted from September 2024 to April 2024, to estimate the prevalence and assess associated risk factors of poultry coccidiosis. A cross-sectional questionnaire survey was used to capture the practices of owners engaged in intensive poultry production systems.

Sampling Techniques and Sample size Determination

Study districts, Arba Minch town and Arba Minch Zuria, were selected purposefully based on the number of chickens on the farms. A two-stage cluster sampling method was used to select poultry farms from the study area. First, poultry farms/ clusters were sampled using simple random sampling. Next, individual chickens from the selected cluster were sampled using a simple random sampling. Ink or dye was applied to each sampled chicken in order to avoid double sampling. A 95% confidence interval was used to determine the sample size for this study based on the two-stage cluster sampling method using a 37% expected prevalence, 5% desired absolute precision and Design effect (an adjustment factor for clustering). Then, the formula of second-stage cluster sampling method is

$$g=\frac{1.96^2 \times D \times P\ exp\ (1-Pexp)}{d^2}$$

Where:

g= number of clusters to be sampled; n = predicted average number of animals per cluster (n=65); Pexp = expected prevalence (Pexp = 37%); d = desired absolute precision (d = 5%); D= (0.0157) Design effect (an adjustment factor used to allow for clustering [25].

Therefore, the number of poultry farms/clusters in the study area (g = 65) and the number of chickens 1004 chickens were sampled for prevalence study. The intended number of poultry farms/clusters is 16 and chickens to be sampled were proportionally clustered by the size. This was based on the estimated number of poultry farms and chickens present in the district and each kebele.

The sample size for determining household for questionnaire survey was obtained using probability proportionate sampling technique [26]:

$$n = \frac{z^2 * p\,(q)}{d^2}$$

Where, n is desired sample size according to cochran [26] when population household is > 10,000; z is the standard normal deviation (1.96 for 95% confidence interval); p is 0.1 (proportion of population to be included in sample i.e. 10%); q is 1 - p that is 0.9 (90%); d is the degree of accuracy desired (0.05) or 5% error term.

Methodology

Questionnaire: Semi-structured questionnaire was used to collect demographic and basic information about the production system and the management practice in the study area. A total of 138 households are used for semi-structured questionnaire surveys and this proportionally was allocated for each study site.

Parasitological examination: Fecal samples from each chicken were collected with a spatula from freshly voided feces. Fecal samples were collected in sampling universal bottles, identified appropriately, and transported to Arba Minch University College of Agriculture, Veterinary laboratory for analysis. Before microscopic observation, floatation techniques were performed to concentrate the oocysts in order to increase the sensitivity of the examination. Sodium chloride solution was used as a floating medium. The diagnosis of the oocysts in the feces was made using a 10x optical lens of the microscope.

Post-mortem examination: Post mortem examination was conducted on *Eimeria* Oocyst positive poultry to observe gross lesions associated with coccidiosis. The gastro-intestinal tract was thoroughly examined for gross pathological changes [22-26]. The intestinal portions were divided into 4 sections: the upper part (duodenum and jejunum), the middle part (ileum), lower part (distal ileum and rectum) and cecal pouches. The intestinal wall of different sites was examined for thickening, petechiae, coagulative necrosis, reddening, whitish spots, cecal cores, or bleeding. Then, the mucosal scrapings were taken to examine the protozoan developmental stage along with lesions by microscopic examination according to Lobago et al. [27]. The observed gross pathological lesions were recorded.

Identification of species of Eimeria: Species of *Eimeria* were identified by combination of microscopic features of oocyst morphology (shape, size, sporulation time and color of the oocysts), the predilection site of *Eimeria* in the gut and the nature of gross lesions by post mortem examination.

Data management and analysis

All the surveyed data was analyzed using STATA 14. Descriptive statistics was employed to present the results. Analyzed data was presented using tables, percentage, and odds ratios. The association between the dependent variable, coccidiosis status (0 = negative and 1 = positive) and categorical independent variables was assessed using logistic regression analyses with significant differences at $p < 0.05$. The degree of association between risk factors and the prevalence of coccidioisis was analyzed using odds ratio. All variables with p-value <0.05 in the initial univariable analysis were checked for multicollinearity using correlation matrix and those variables whose gamma value ranged between −0.6 and +0.6 were considered in a multivariable logistic regression analysis. Finally, the model was assessed for goodness-of-fit using the Hosmer-Lemeshow method. In this analysis, statistical significance was set at $p < 0.05$.

RESULTS AND DISCUSSION

Prevalence of coccidiosis

The result of present study illustrated that poultry coccidiosis is prevalent in and around Arba Minch town; Southern Ethiopia with an overall prevalence of 21.81% (219/1004). This result was in agreement with the finding in Ambo by Olijira et al. [27], and in Arsi Tiyo district by Gari et al. [22] who reported a prevalence of 20.57% and 22.58%, respectively. In the current study the prevalence of poultry coccidiosis is lower than the findings of Dinka and Yacob [28] 71.1% in Debre Zeit, Gari (70.95%) in Tiya district of Arsi zone and also much lower, as compared to findings in Nigeria by Muazu et al.,[29] and in Pakistan by Bachaya et al, [30] reported 52.9% and 36.6%; 60.16% and 37% in young and adult, respectively. The possible reason to varying prevalence of coccidiosis in the current study might be ascribed mainly to the application of preventive measures which are basically biosecurity and use of anticoccidial drugs given at early stages of age.

Out of 314 chickens examined from Arba Minch town and 690 from Arba Minch Zuria District, 68 (21.66%) and 151 (21.88%) were found infected by different *Eimeria* species, respectively (Table 1). In the current study results of poultry coccidiosis estimate in two districts are almost similar. This indicates agro-ecological similarity between the kebeles, endemicity of the diseases in the study area, having almost similar preventive and control approaches.

In this study, the prevalence of coccidiosis was 20.57% in chickens (< 6wks), 23.53% in growers (7-15wks) and 20.98% in adults (> 16 wks). It was observed that there

Table 1: Prevalence of coccidiosis in the two districts of study areas.

Administrative area	Kebeles	No. Examined	No positive	Prevalence (%)
Arba Minch town	Doysa	46	10	21.74%
	Bere	62	12	19.35%
	Wuha Minch	74	15	20.27%
	Gurba	40	9	22.50%
	Edget Berr	34	8	23.53%
	Limat Woze	58	14	24.14%
	Total	**314**	**68**	**21.66%**
Arba Minch Zuria	Genta Bonke	126	28	22.22%
	Genta Meche	162	37	22.84%
	Zeyse Wozeka	202	45	22.28%
	Shelle mela	66	15	22.73%
	Chano mile	50	11	22%
	Lante	84	15	17.86%
	Total	**690**	**151**	**21.88%**
Total in districts		**1004**	**219**	**21.81%**

Table 2: Overall Prevalence of poultry coccidiosis

Variables	Category	No. examined	No. positive	Prevalence (%)
Age	Chick (< 6wks)	282	58	20.57%
	Grower (7-15wks)	374	88	23.53%
	Adult (> 16 wks)	348	73	20.98%
Sex	Male	379	80	21.11%
	Female	625	139	22.24%
Breed	Brown Bovans	469	96	20.47%
	Sasso	535	123	22.99%
Clinical status	Clinical	329	97	29.48%
	Subclinical	675	122	18.07%
Body conditions	Poor	122	30	24.59%
	Moderate	320	67	20.94%
	Good	562	122	21.71%
House type	Floor	706	160	22.66%
	Cage	298	59	19.80%
Litter moisture	Wet	366	95	25.96%
	Dry	638	124	19.44%
Feed and water sanitation	Poor	731	163	22.30%
	Good	273	56	20.51%
Water source	Tap water	241	175	18.26%
	River water	763	44	22.94%
Feed source	Industrial	647	127	19.63%
	Home grains	357	92	25.77%
Anticoccidial provision	Provided	923	180	19.50%
	Notprovided	81	39	48.15%

was no statistically significant difference in the prevalence of coccidiosis among the three different age groups examined (p>0.05, Table 3). The prevalence of coccidiosis in chickens less than 6 weeks of age and adults are almost similar. This similar occurrence observed might be due to the management system, exposure to infectious dose and acquired or maternal immunity. The amount of oocyst discharged from infected chicken depends on the dose of oocysts ingested and the immunological status acquired from previous exposure [31]. Therefore, the opportunity of the chickens to pick-up large numbers of sporulated oocyst might be equal in the age categories.

This study also indicated that the prevalence of coccidiosis was relatively similar both in females (22.24%) and male (21.11%) chicken (Table 2). This result agrees with the previous studies of Gari et al., [22] and Alemayehu et al, [32]. In the present study, occurrence of coccidiosis was statistically not significant between the sex groups (p>0.05). Absence of statistically significant difference between male and female may be due to equal chance of exposure for the parasite infection. This indicates there is no significant natural resistance variation in relation to the sex [33].

The current study revealed 20.47% and 22.99% of prevalence of coccidiosis in the brown bovans and sasso T44 breed, respectively with no statistically significant difference(Table 2) (p>0.05). The occurrence of coccidiosis is slightly higher in sasso breed than bovans brown breed (Table 2). The prevalence of coccidial infection in the study breeds of chickens in the present study was lower than in previous findings by Wondimu et al. [6] 46.1% in Bovan brown and 26.3% sasso T44 breed. However, the finding in this study is in line with the finding of Ahmed et al. [34] in Egypt and Tehetena [35] who recorded 21.24% and 23.1%, respectively. This may be related to the exposure of chickens genetically derived from similar parent breeds [36]. However, it has long been known that different breeds of chicken may have different degrees of “susceptibility” or “resistance” to Coccidia species, including tolerance to infection and speed of recovery from the pathological consequences of infection [37].

In this study the prevalence of coccidiosis was higher in apparently sick chickens than in apparently healthy chickens with prevalence of 29.48% and 18.07% respectively (Table 2). Similarly, higher prevalence reported in apparently sick chickens than in apparently healthy chickens by [38,39]. The prevalence of the disease was statistically significant with the frequency of observable clinical signs of sickness (p=0.026) (Table 3). This is because apparently healthy chickens have high immunity against the coccidial infection and clinically diseased chickens have suppressed immune to the infection and also have impaired feed conversion.

The effect of disease on body condition showed that higher prevalence reported in poor body condition chickens (24.59%) than medium (20.94%) and good body condition (21.71%) (Table 2). This result agrees with reports of different researchers in Ethiopia who showed higher in poor body condition with 19.3% prevalence of poultry coccidiosis in Yabello by Addis and Endale [40],

Table 3: Univariable logistic regression analysis result

Variables	Category	No.examined	No.positive	Odd ratio	95% CL	p-value
Age	Adult (>16wks)	348	73	Ref		
	Chick (< 6wks)	282	58	1.00	0.66 – 1.53	0.9800
	Grower(715wks)	374	88	1.20	0.81- 1.79	0.360
Sex	Male	379	80	Ref		
	Female	625	139	1.05	0.75 - 1.47	0.760
Breed	Brown Bovans	469	96	Ref		
	Sasso	535	123	1.11	0.81 - 1.53	0.510
Clinical status	Subclinical	675	122	Ref		
	Clinical	329	97	1.47	1.05 – 2.07	0.026
Body conditions	Good	562	122	Ref		
	Poor	122	30	1.09	0.67 – 1.75	0.730
	Moderate	320	67	.86	0.52 -1.44	0.572
House type	Cage	298	59	Ref		
	Floor	706	160	1.23	0.87 – 1.75	0.240
Litter moisture	Dry	366	95	Ref		
	Wet	638	124	.46	0.11 - 1.95	0.294
Feed and water sanitation	Good	273	56	Ref		
	Poor	731	163	1.09	0.77 – 1.56	0.620
Water source	Tap water	241	175	Ref		
	River water	763	44	1.49	1.02- 2.20	0.040
Feed source	Industrial	647	127	Ref		
	Home grains	357	92	.65	0.16- 2.77	0.566
Anticoccidial	Provided	923	180	Ref		
	Not-provided	81	39	3.12	1.87 - 5.20	0.000

20.3% in Mekele by Birhane and Nibret [41] and 20.57% in Ambo [24]. This may be associated with highly exposed chickens, caused to have poor body condition as a result of low nutrient absorption and increased infection due to the decreased immunity that predispose for coccidiosis.

Higher proportion of poultry coccidiosis was seen in the floor system (22.66%) than the cage system (19.80%) with no statistically significant difference (Table 3). Similarly, Hadas et al., [42] reported higher prevalence in the floor system. This may be due to higher exposure of chickens to the sporulated Eimeria oocyst in the floor system. It has been reported that management practices such as overcrowding, leaking water troughs and accumulation of faces are factors that could contribute to the high prevalence of coccidiosis [43]. These management practices warm and moisture environments that favors greater transmission and contamination of oocysts.

The proportion of coccidiosis was higher in chickens that were drinking river water (72.61%) than the chickens that were drinking tap water (5.77%), having statistically significant difference between the categories (p=0.040). This is because the river water is easily exposed to contamination with waste material harboring Eimeria oocyst which can cause poultry coccidiosis. This report agrees with the reports of Tadesse and Feyessa [44] (OR = 1.57, p = 0.032) and Amaral [45]. Accumulation of feces and contamination of water as in the case of river water by fecal materials increases the number of *Eimeria* species oocysts [46].

Risk factors associated with prevalence of poultry coccidiosis

Risk factors were assessed for the presence of statistically significant association between putative factors and the prevalence of poultry coccidiosis using univariable logistic regression analysis. Among the potential risk factors, three variables were found to be statistically (P<

0.05) associated with prevalence of poultry coccidiosis in analysis of univariate logistic regression (Table 3).

The final logistic regression model revealed that clinical status, water source, litter moisture, anticoccidial provision remained significant predictors of poultry coccidiosis in farms ($P < 0.05$) (Table 4). The fitness of the model for the data was also checked. The Hosmer-Lemeshow goodness-of- fit test suggested that the model fit the data ($\chi 2 = 7.79$; $P = 0.45$).

The odds of having coccidia in clinically sick chickens was 49% more likely to harbor coccidia than the subclinical cases (OR = 1.49; p = 0.022). In line with Tadesse and Feyessa [47] reported that clinical chickens are 57% more likely to harbor coccidia compared with subclinical cases (OR =1.57, p = 0.032). Apparently sick chickens show depression, blood mixed diarrhea and excessive poor body condition (emaciated) than in apparently healthy chickens. This is because apparently healthy chickens have high immunity against the coccidial infection. Additionally, it implies that coccidiosis is an important disease that affects the apparent health status of chickens as well as it is a disease of might flare up during the chickens exposed to the other disease(s). This result is in agreement with the previous report of McDougald [48].

The odds of being infected with coccidian in chicken reared on dry litter was 42% higher than in those reared on wet litter system with statistically significant difference (OR = 1.42; p<0.027) (Table 4). This may be due to higher exposure of chickens to the sporulated Eimeria oocyst in the floor system. It has been reported that environments such as overcrowding, leaking water troughs and accumulation of faces are factors that contributed to the high prevalence of coccidiosis [43].

The odds of getting coccidiosis for the chickens that were drinking tap water is 32% less likely than the chickens that were drinking river water (OR=0.68, P=0.046). Similarly, Chalchisa (2016) reported that the odds of getting coccidiosis in the chickens that were drinking tap water is 41% less likely than the chickens that were drinking river water. According to Amaral [45], drinking water plays an important role in the transmission of protozoan diseases that are among the most common poultry diseases. Accumulation of feces and contamination of feed and water as in the case of river water by fecal materials increases the number of *Eimeria* species oocysts [46].

Table 4: Multivariable logistic regression analysis on different risk factors.

Risk factors	Category	OR	95% CI	P-value
Clinical status	Subclinical	Ref		
	Clinical	1.49	1.06-2.09	0.022
Litter moisture	Wet	Ref		
	Dry	1.42	1.04-1.94	0.027
Water source	River water	Ref		
	Tap water	0.68	0.46-0.99	0.046
Anticoccidial	Provided	Ref		
	Not provided	3.11	1.87-5.16	0.000

Post-mortem examination

During postmortem examinations, specific *Eimeria* species were identified by their sites of occurrence and characteristics of their lesions (Table 5). Out of 24 chickens, 19 (79.17%) were positive to coccidiosis by mucosal scrap examination, and pathological lesions of intestine and caecum. E. *tenella* is one of the most widespread species that induced hemorrhage, clotted blood and cecal cores in the cecum. E. *necatrix* and E. maxima usually shared similar intestinal lesions. Lesions in E. *necatrix* were more severe with bleeding and whitish plaques seen in the middle intestine on both sides from yolk sac diverticulums (Table 5-8). Lesions induced by E. *acervulina* was seen in the duodenal loop and characterized by mucoid exudates in intestinal content and white spots usually evident from the serosal side [28]. E. *burnette* was parasitized and seen in the lower intestine. E. *burneti* was induced petechial haemorrhage was recognized on the serosal than the mucosal surface that appeared in small areas [49].

The gross pathological observations for each species were quite similar to what was previously described in other studies [19-50]. The observed lesions caused by E. maxima and E. *necatrix* infections might be occasionally misdiagnosed as coccidiosis, particularly when concomitant with coccidiosis [51] and necrotic enteritis [52].

Identification of Species of Eimeria

In this study, five *Emerian* species, namely *E. tenella*, E. *necatricx, E. maxima,*E. burnetti, and *E. acervulina* were identified. *E. tenella* occurred most frequently with prevalence of 37.44%, whereas the remaining four *Eimeria* species identified *E.necatrax,* E. maxima, *E. burnetti,* and *E. acervulina* were low and accounts for 18.72%, 16.44%, 15.53%, and 11.87%, respectively (Figure 1). These results are in agreement with the previous reports from Ethiopia [20-28] reports four species of Eimeria except E. maxima. However, reports in Nigeria by Muazu et al, [29]; in Iran by Mohamed et al. (2011) and in Pakistan by Bachaya et al. [30] were also reported four *Eimeria* species except E. *burnetti,* suggesting that those species of *Eimeria* are widespread in many countries. The prevalence of infection in studied chickens in the current study shows the maintenance of oocysts in the farm and external environment, improper cleaning and disinfection methods in the chicken house.

Table 5: Postmortem lesion examinations for poultry coccidiosis

Site affected	Nature of gross lesion	Species identified	Noof cases with lesion
Duodenum	White lesions and the mucosa sometimes showHemorrhagic appearance.	E.*acerveillena*	4
Jejunum	Petechiae, the jejunum thickened and ballooned with red pinpoint.	E. *maxima* and E.*necatrix*	6
Ileum	Thin intestinal wall and hemorrhages	*E. burnette*	5
Caecum	Thickened and ballooned, its content mixed with blood	E.*tenella*	9

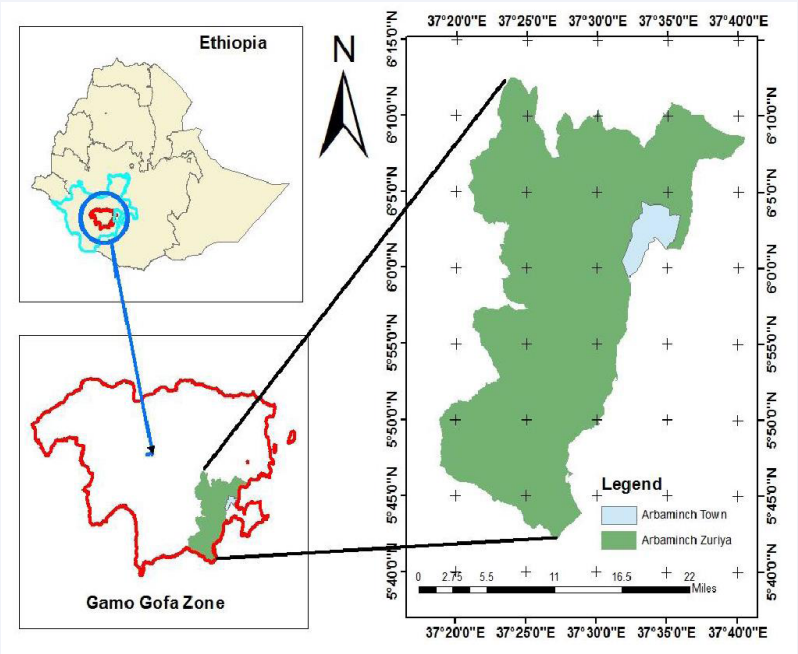

Figure 1 Location of Study Area on Map

Conversely, as reported in Ethiopia by Ashenafi et al. [20], and in Iran by Nematollahi et al. [15], disclosed that E. acervulina was a predominant species of *Eimeria* On the other hand, Lobago et al. [27], reported that E. burnetti was the most prevalent species in Ethiopia. The probable reasons for this discrepancy could be differences in farm sanitation and /or due to exposure to the prophylaxis used as anticoccidial drugs in feed and water or may be due to breed differences.

The occurrence and incidence of coccidiosis is also, to a great extent, affected by the type of chick reared and breed sensitivities to infection [53]. Many coccidiostatics drugs have been directed against E. tenella, with the result that other species are increasingly incriminated as a cause of poultry coccidiosis [54].

Status of poultry coccidiosis in Ethiopia

Poultry coccidiosis is endemic in Ethiopia, causing abundant economic losses mainly in young chickens, in all production systems. For instance, proportion rate of 50.8% and 11% in deep litter intensive systems and backyard extensive production systems, respectively, were reported from Debrezeit and its surroundings. Moreover study on the occurrence of coccidiosis and distribution of Eimeria species in dead chickens of 1-60 days of age, at Kombolcha Poultry Multiplication and Research Centre (KPMRC), Ethiopia indicated that out of 965 dead chickens, 370 (38.34%) were found to have clinical coccidiosis. The *Eimeria* species identified in those studies were E. brunetti, E. tenella, E. acervulina and E. necatrix with prevalence of 45.3%, 40.8%, 9.7% and 4.1%, respectively [27].

Poultry occidiosis, caused by for example Eimeria acervulina, Eimeria necatrix, *Eimeria* maxima and Eimeria tenella, is endemic in all parts of the country and affects mainly young growing chickens [18].The species of coccidia identified in Ethiopia are E. tenella, E. necatrix, E. maxima and E. acervulina, E. mivati and E. brunetti [27].

Studies conducted in Arsi zone (Tiyo district) revealed prevalence rates of 22.58% and 12.25% for clinical

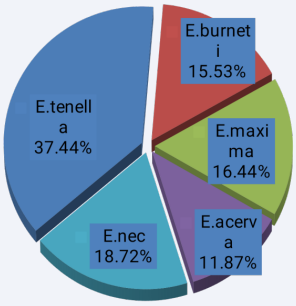

Figure 2 *Eimeria* species wise prevalence

Table 6: Prevalence of coccidiosis in different areas of Ethiopia

Site of study	Prevalence	Reference
Hawassa	65.1%	Muluken and Liuel (2017)
Bahir dar	40.6%	7
Mekele	20.3%	41
Gonder	53.6%	8
Yabello	19.3%	40
Kombolcha	48.5%	63
Adama	56.3%	Ermias and Mekonnin (2015)
Dire dewa	42.7%	Migbaru and Abdi (2015)
Central Ethiopia	25.8%	[20]
Gonder	43%	[42]
Addis Abeba	23.1%	[32]
Debre zeit	71.7%	[28]
Arsi tiya district	64.4%	[22]
Kombolcha	38.34%	[27]
Ambo	20.57%	Olijira *et al.*, (2015)
Site of study	**Prevalence**	**Reference**
Hawassa	65.1%	Muluken and Liuel (2017)
Bahir dar	40.6%	[7]
Mekele	20.3%	[41]
Gonder	53.6%	[8]
Yabello	19.3%	[40]
Kombolcha	48.5%	[63]
Adama	56.3%	Ermias and Mekonnin (2015)
Dire dewa	42.7%	Migbaru and Abdi (2015)
Central Ethiopia	25.8%	[20]
Gonder	43%	[42]
Addis Abeba	23.1%	Alemayehu *et al.*, (2012)
Debre zeit	71.7%	[63]
Arsi tiya district	64.4%	[22]
Kombolcha	38.34%	[27]
Ambo	20.57%	Olijira *et al.*, (2015)

Table **7**: Respondent's bibliography

Variable	Category	Respondents	Distributions
Sex	Male	61	(44.2%)
	Female	77	(55.8%)
Age	Young	55	(39.9%)
	Adult	83	(60.1%)
poultry keeping experience	<1year	2	1.45%
	1-5years	54	(39.13%)
	>5years	82	(59.4%)
Awareness about coccidiosis	No	98	71.02
	Yes	40	28.98

Table 8: Questionnaire survey in the study area.

Variables	categories	No. of respondents	Distributions
Breed of chicks reared	Bovans brown	78	56.52%
	Saso	46	33.33%
	Others	14	10.14%
major problems farms face	Disease	103	74.64%
	environmental stress	12	8.69%
	management related	53	38.40%
Major disease problems	Lice	24	17.39%
	Fowl pox	56	40.58%
	Newcastle	89	64.49%
	coccidiosis	61	44.20%
	worms	23	16.66%
Vaccination	No	27	19.56%
	Yes	111	80.43%
Type of treatment used	Oxytetracycline	87	63.04%
	sulfonamides	76	55.07%
	Amprolium	23	16.66%
	Vitamins	34	24.64%
Awareness about control of coccidiosis	No	98	71.02%
	Yes	40	28.98%
predisposing point	water source	56	40.58%
	feed source	66	47.83%
	market place	22	15.94%
	working equipment	52	37.68%

coccidiosis in Rhode Island red (RIR) and local strain chickens respectively [22]. Additional investigation done in central Ethiopia revealed that *Eimeria* acervulina was the most prevalent coccidial species [27-55], whereas study conducted in Kombolcha disclosed that *Eimeria* burneti was the most prevalent coccidian species .This variation may be because of the possibility of drug resistance or/and differences in virulence of *Eimeria* species under different management systems.The possible risk factors associated with the outbreak of coccidiosis in Ethiopia were reported as absence of proper disposal of litters, wetting of litters from leaking pipes, absence of all- in all- out system, the presence of stressors (such as change in diets and concurrent infections) and extensive use of coccidiostats [43]. Moreover, [22].have reported that the potential risk factors for the occurrence of coccidiosis in free-ranging local chickens were non-selective picking behavior during feeding, age group, high moisture conditions whereas in Rhode Island Red (RIR) breeds that were kept under intensive deep litter system, the potential risk factors observed from farm assessment through questionnaire were age groups, production systems, flock size, moisture level in the poultry house and level of biosecurity.

Questionnaire survey result

Demographic characteristics of Respondents: Of 138 poultry owners, 69 from Arba Minch town

administration and 69 from Arba Minch Zuria district were involved in the survey to investigate the awareness about the poultry rearing practice. 61(44.2%) respondents were male and 77(55.8%) were female respondents. The higher proportion of female respondents than males reflected the fact that poultry rearing is mainly managed by females, as it was also reported by Desalew [56], and Khandait et al [57]. Most of the respondents (59.4%) were reared poultry for more than five years, 54(39.1%) of respondents reared for 1-5 years and 1.4% were reared for the first course with experience less than a year.

Production, Disease Problems and Awareness about Coccidiosis: The majority (56.52%) of the respondents keeps bovans brown breed, 33.33% sasso T144 and 10.14% of farmer rears other breed. And the source of chicks for the poultry farmers was private hatcheries.

About 74.64% of respondents complained of disease as a major constraint. Other constraints of production were management related problems 38.40% and environmental stress (8.69%). The most predominant chicken disease observed by farmers in descending order of importance were newcastle (64.49%), coccidiosis (44.20%), fowl Pox (40.58%), lice (17.39%) and worms (16.67%) in the study area. In the present study areas coccidiosis was reported as the second major disease problem, followed by management related problems and environmental stress. Similarly, Desalewu, (2012), reported disease as a major constraint of poultry production in East Shewa, Ethiopia. According to respondents' view, most of respondents (71.02%) lack awareness about the effect and control methods of coccidiosis.

The survey also revealed that the farms and chicken keeping households use different antimicrobial and antiprotozoal drugs to treat their poultry. The commonly used anticoccidial drugs were oxytetracycline, amprolium and vitamin supplements [58,59]. Among this Oxytetracycline was used by the majority of the respondents 63.04%. This is in line with reports by [60,61]. However, the use of the antibiotics is mostly not based on any prescription from the veterinarian but by the farmers themselves which indicates irrational use of the drugs in the study area as reported by Sharma et al., [62,63].

CONCLUSION AND RECOMMENDATIONS

The result of the current study showed poultry coccidiosis is the most common encountered and important disease affecting chicken production in in the study area with an overall prevalence of 21.81%. Clinical status, water source, litters moisture, anticoccidial provisions are found to be potential risk factors for the occurrence of poultry coccidiosis in the study area with Statistically Significant difference ($p<0.05$).

Even though the reduced prevalence of coccidiosis reported in the present study, coccidiosis is a major burden to small scale poultry owners. The coccidia species identified were E. tenella, E. necatrix, E. maxima, E. burnette and E. Acervulina. E. tenella were the predominant species. The finding also implied that coccidiosis is one of the most economically important diseases under poorly managed systems, Wet and moist litters in poultry houses are suitable to develop oocysts into sporulation and could increase the risk of coccidiosis.

Therefore, the following recommendations are forwarded:

- Commitments toward educating the local chicken farmers especially in villages to control coccidiosis through good hygienic practices, and the proper use of anticiccidial drugs should be considered.
- Good biosecurity practices and Anticoccidial should be given regularly for the prevention and control of coccidiosis so as to decrease the prevalence of coccidiosis observed in this study area.
- To control this economically poultry coccidiosis, further studies need to be undertaken to formulate sustainable and cost-effective prevention and control methods.

Ethical Consideration

For this study, the data was obtained through written informed consent acquired from all study participants, and it was approved by the concerned research ethical committee of the AMU. The respondent's confidentiality was maintained; his/her answers were not being released to anyone and it remains anonymous and the name of respondent will not be written on questionnaire or be kept secure. On the other hand, his/her participation is based on his/ her voluntary and he/she may choose to stop the interview at any time.

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Declaration

I hereby declare that this research is my original work and has not been presented for a degree in any other university, and all sources of material used for this thesis have been duly acknowledged.

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