

carcasses from all cattle slaughtered during the prospective study period for flukes and other pathological abnormalities characteristic of fasciolosis. To check for the parasites, an incision was made on each liver, gall bladder and bile ducts. The parasites that were recovered from the livers of the slaughtered cattle that were infected appeared to have the gross morphological characteristics that are typical of *Fasciola gigantica*. These characteristics include a long-tapered form, the orientation of the suckers, and slim shoulders (**Figure 1**).

Fasciolosis incidence was documented for each animal's age, sex, and breed to learn more about the factors that contributed to the disease. [21] proposed a method for estimating an animal's age by examining its dentition, which was used here to divide the animals into two age groups: young and adults.

Verbal consent was sought from the Head of the Jalingo abattoir before the data were collected from the abattoir.

If postmortem inspection of the carcass reveals the presence of *Fasciola* or characteristic pathological lesions in the liver, it was classified as positive.

Statistical analysis

Statistical Package for the Social Sciences (SPSS) Version 25 (IBM Statistics) was used to perform descriptive and inferential statistics. The data obtained were presented using frequency and percentage.

The prevalence of bovine fasciolosis was calculated by comparing the percentage of carcasses with fasciolosis found during postmortem examination to the total number of cattle slaughtered during the time periods under consideration.

Additionally, the chi-square test was used to determine the associations of breed, age, and sex of the slaughtered cattle with the prevalence of bovine fasciolosis in the inspected cattle during the prospective study from March to April 2022, and a value of $p < 0.05$ was considered statistically significant throughout the study.

Figure 1. Gross pathological lesion in a cut section of bovine liver in Jalingo Abattoir (A) and *Fasciola gigantica* expressed from the bovine liver (B)



Results

A total of 149,611 cattle were slaughtered between January 2012 and December, 2021 with an average of 1,247 per month (**Table 1**). The Jalingo abattoir record showed that a total of 12,397 (8.29%) of the cattle inspected during the period were observed to be infected with bovine fasciolosis lesion.

From the retrospective record, the annual bovine fasciolosis prevalence ranged from 5.51% to 12.20%, with an average of 8.9%. From the year 2012 - 2015 there was a persistent decrease in the annual prevalence of bovine fasciolosis from 12.20% to 5.51% and then an increase to 8.88% in 2016. There was significant statistical association ($p < 0.05$) between the prevalence of bovine fasciolosis and the period of study (**Table 1**).

Postmortem records from Jalingo abattoir showed that 85,685 of the cattle were slaughtered during the rainy season with 7,288 of the cattle infected with bovine fasciolosis, while 62,330 cattle in dry season were slaughtered with 5,109 of them infected with the disease (**Table 1**).

The results of the seasonal retrospective analysis of fasciolosis from the year 2012 to 2021 point to a statistically significant relationship between the seasons and fasciolosis occurrence (p -value = 0.034). Fasciolosis was shown to be 8.5% more common during the rainy season in the study. In contrast, the prevalence decreased during the dry season to 8.2%. However, based on the findings of this retrospective study, there is an association between the seasons and the frequency of bovine fasciolosis, with the rainy season showing a

marginally greater prevalence than the dry season (**Table 1**).

An incidence of 208 (8.58%) bovine fasciolosis was obtained in the inspected cattle slaughtered during the prospective study at Jalingo abattoir for the period of March and April 2022.

Female cattle had a prevalence 149 (6.15%) than bulls 59 (2.43%). The survey also found that female cattle, which make up 72.4% of the overall number of slaughtered cattle in the Jalingo abattoir, were the most frequently slaughtered (**Table 2**).

Out of the 2424 cattle inspected during the study period, 1881 of adult cattle had a bovine fasciolosis infection rate of 141 (5.82%), while 543 were young cattle with infection rate of 67 (2.76%), and age of the cattle was significantly associated with the incidence of bovine fasciolosis (**Table 2**).

Table 2 showed that there was a higher infection rate in the cattle breed 134 (5.53%) White Fulani than in the 37 (1.53%) Red Bororo, 20 (0.83%) Sokoto Gudali, and 17 (0.70%) Adamawa Gudali cattle breeds (**Table 2**).

The results of the Chi-square test showed that there was no statistically significant relationship ($p > 0.05$) between bovine fasciolosis and the breed and sex of the slaughtered cattle (**Table 2**).

The parasites that were recovered from the livers of the slaughtered cattle that were infected appeared to have the gross morphological characteristics that are typical of *Fasciola gigantica*. These characteristics include a long-tapered form, the orientation of the suckers, and slim shoulders (**Figure 1**).

Table 1. Annual Prevalence of Bovine Fasciolosis encountered at Jalingo Abattoir, Taraba State, Nigeria (2012 – 2021).

Variables	Number of Cattle Slaughtered	Number of Slaughtered Cattle with Fasciola	Prevalence (%)	<i>p</i> - value
Year				0.001*
2012	13,670	1,668	12.20	
2013	14,196	1,545	10.88	
2014	14,968	1,215	8.12	
2015	16,148	889	5.51	
2016	11,653	1,035	8.88	
2017	12,124	1,167	9.63	
2018	19,630	1,244	6.34	
2019	16,931	1,261	7.45	
2020	14,846	1,177	7.93	
2021	15,445	1,196	7.74	
Season				0.034*
Rainy (April – October)	85,685	7,288	8.50	
Dry (November – December)	62,330	5,109	8.20	
Total	149,611	12,397	8.29	

Table 2. Incidence of Bovine Fasciolosis encountered at Jalingo Abattoir, Taraba State, Nigeria (March – April, 2022).

Variables	Number of Cattle Slaughtered	Number of Slaughtered Cattle with Fasciola	Chi-square (χ^2)	<i>p</i> - value
Age			12.598	0.000*
Young	543	67		
Adult	1881	141		
Sex			0.067	0.796
Male	669	59		
Female	1755	149		
Breed			1.763	0.623
White Fulani	1475	134		
Red Borroro	444	37		
Adamawa Gudali	253	17		
SokotoGudali	252	20		
Total	2424	208		

Statistically significant*

Discussion

The ten-year retrospective prevalence of bovine fasciolosis (8.29%) was higher than the bovine fasciolosis prevalence reported by

Yatswako et al. [22] during a ten-year retrospective study in Niger State, North-central Nigeria; higher than the bovine fasciolosis prevalence reported by Oladele-Bukola et al. [23] in Ibadan, Oyo State in an eleven-year retrospective study; and the bovine

fasciolosis prevalence in a four-year retrospective study reported by **Ibironke** [24] in Agege, Lagos, Nigeria. However, the prevalence in this study was lower than the prevalence observed from condemned cattle livers in a five-year retrospective analysis at Makurdi abattoirs reported by **Ejeh et al.** [25], while **Raji et al.** [26] reported a 23.41% prevalence of bovine fasciolosis during a nine-month study in Zaria. The prevalence discrepancies may be attributable to a number of factors, including differences in livestock management and livestock movements, as well as variances in meteorological and ecological circumstances such as precipitation, seasons, temperature, humidity, and access to water source [7, 22].

This study found that bovine fasciolosis is more common during the wet season. The association between bovine fasciolosis and the season was statistically significant. Studies by **Ahmad et al.** [16] in Zamfara State, **Isah** [15] in northern Bauchi State, and **Yatswako et al.** [22] in Niger State all show similar patterns, lending credence to these findings. This research finding agrees with report of **Njoku** [27] in Southeastern State of Nigeria. The high frequency of bovine fasciolosis occurrence during the rainy season is most likely caused by the abundance of snails on the pastures during this season and, more so, by the likelihood that cattle can pick up more of the metacercarial cyst while grazing in the early rains, along riverbanks, and near water sources. Animals that spend time grazing near the banks of rivers and lakes are at increased risk of contracting *Fasciola* [7]. Our results are in line with those of **Damwesh et al.** [28], who discovered a similar high frequency of bovine fasciolosis during the rainy season in the state of Adamawa, northeastern Nigeria. At the beginning of the rainy season, when snails (*Lymnea* spp.), the intermediate host for *Fasciola*, emerge from hibernation stage and release enormous numbers of metacercarial cyst [27, 29, 30], cattle become infected by ingesting these parasites while grazing. In addition, **Qureshi et al.** [31] noted that metacercariae are abundant on plants around riverbanks, lakes, and streams during the rainy and early dry seasons. However, **Oladele-Bukola et al.** [23] found that the average prevalence was higher in Ibadan during the dry season of the year than during the rainy season. Similarly, **Ejeh et al.** [25] found a higher frequency in Makurdi during the dry season of the year than in the rainy season. **Oladele-Bukola et al.** [23] noted that during the dry season, Fulani

nomadic herders are known to migrate to the southern part of Nigeria in search of lush vegetation and water; this allows the cattle to consume the infected *Fasciola* larva while foraging on the available pasture. Livestock markets in the Southern part of the country are a common destination for these animals after their travel.

However, in this study more cattle were slaughtered during the rainy season compared to dry season, this may be because there has been an overall surge in the supply of cattle, which has led to a proportional drop in price during the rainy seasons.

The prospective study found a prospective prevalence of 8.58 percent bovine fasciolosis. However, compared to the 28.2% fasciolosis detected through the presence of *Fasciola* eggs that was reported by **Shinggu et al.** [32] in Wukari, Taraba State, and the prevalence of bovine fasciolosis obtained in the current study was low.

In this prospective study, age was statistically significant with the occurrence of bovine fasciolosis which is inconsistent with the findings of **Yatswako et al.** [22] but however contradict this study findings which found that old age has a substantial impact on the frequency with which fasciolosis occurs in cattle. **Yatswako et al.** [22] reported the presence of bovine fasciolosis in young cattle than adult ones and speculated that the developed immune system and acquired immunity in adults would result in resistance. However, the findings from this current study are comparable with those of **Ahmad et al.** [16] and **Vassilev** [33], who observed that the prevalence of bovine fasciolosis increases with age. This trend was attributed to the fact that older animals have had more time to become infected and hence have more liver fluke accumulated in their livers than younger cattle. **Shinggu et al.** [32] and **Tsegaye et al.** [34] reported that no significant variation in infection rates was found between age groups. The slaughtered cattle overwhelmingly consisted of females cattle. This is likely due to the fact that female cattle are cheaper to purchase than bulls. This may also be due to the fact that cattle farmers keep female cattle longer in the farm for breeding and milk production purposes. **Shinggu et al.** [32], **Abubakar et al.** [35], and **Magaji et al.** [36] all found the same result, stating that there was no discernible gender-based difference in the rates of infection. Female cattle had a greater infection rate with bovine fasciolosis than

male cattle in this study. The incidence was found to be greater in female's cattle than in bulls, which is consistent with the findings of **Shinggu et al.** [32], **Adedokun et al.** [37], and **Ulayi et al.** [38]. The high numbers of fasciolosis seen in female cattle are more likely to be due to biological, physiological, and behavioral variations between the sexes [38].

The White Fulani cattle breed had the highest prevalence of fasciolosis compared to the other breeds studied, followed by the Red Bororo and the Sokoto Gudali cattle breeds. It is possible that variations in genes, the environment, and human intervention are possible factors for these results. However, the management techniques used with specific cow breeds may have had an impact on the risk of exposure and subsequent transmission.

Conclusion

The findings of this research study suggest that bovine fasciolosis is widespread, and still causes significant concerns in cattle populations, especially during the rainy months. This study provides information on the prevalence and seasonal variations of bovine fasciolosis at Jalingo Abattoir. Because bovine fasciolosis is still a major health problem for cattle, retrospective and prospective research is essential to better understanding and controlling the disease. Bovine fasciolosis has a significant influence on animal health and productivity, although this can be reduced with the help of tailored control techniques and continued surveillance and research.

This study emphasizes the need to track and analyse bovine fasciolosis's prevalence and patterns in order to devise efficient control and preventative measures. To combat bovine fasciolosis, a multimodal approach is required, including ongoing surveillance, targeted control measures, breed-specific considerations, and collaboration among key parties, thus, reducing the occurrence of bovine fasciolosis and protecting cattle health, and promoting food safety and public health by applying the aforementioned guidelines.

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Conflict of interest

There is no conflict of interest declared by the authors.

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