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(Original Research)

Prevalence of Gastrointestinal Parasites in Cattle: Influence of Age in Lamongan, East Java, Indonesia

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Abstract

Background: Cattle play a crucial role in Indonesia's agricultural and economic sectors; however, gastrointestinal parasite infections remain a significant constraint on their productivity. This study aimed to determine the prevalence, diversity, and infection patterns of gastrointestinal parasites in cattle in Lamongan Regency, East Java. **Methods:** A total of 120 fecal samples were collected from smallholder farms and examined using standard flotation and McMaster techniques. **Results:** The overall prevalence of gastrointestinal parasites was 65% (78/120). Identified helminths included *Oesophagostomum* sp. (22.5%), *Strongylus* sp. (16.66%), *Trichuris* sp. (10.83%), *Moniezia* sp. (10%), *Toxocara vitulorum* (9.16%), *Haemonchus* sp. (5.83%), and *Capillaria* sp. (4.16%). The only protozoan detected was *Eimeria* sp., which had the highest prevalence (30%). Males exhibited slightly higher infection rates (33.33%) than females (31.66%), and the highest prevalence was observed in calves aged less than 6 months (45.83%). Single infections (79.49%) were more common than mixed infections (20.51%). Although the prevalence was high, most infections were of mild intensity (1–500 eggs per gram of feces). **Conclusion:** These findings underscore the importance of routine parasitological monitoring and integrated parasite control strategies, particularly for young cattle and farms with poor management practices, to reduce productivity losses and improve overall herd health.

Keywords

Cattle, Disease, Gastrointestinal parasites, Parasitic infection, Prevalence

1. Introduction

Fulfilling the dietary protein needs, cattle play a vital role in Indonesia's agricultural system, serving as an essential source of food, income, and rural livelihood [1]. The livestock sector significantly contributes to national food security, community welfare, and employment, while addressing the increasing demand for animal protein driven by population growth and urbanization [2,3]. In Indonesia, approximately 90% of beef production originates from smallholder farms, with the remaining 10% supplied by private enterprises and government-supported programs [4]. Despite its importance, the sustainability of the cattle industry faces numerous challenges, including fluctuating feed availability, limited access to modern farming infrastructure, and the burden of infectious diseases, particularly gastrointestinal parasitic infections [5,6].

Gastrointestinal parasitic infections are a significant constraint in tropical livestock production systems, partly due to the predominance of extensive and free-range farming practices. In such systems, cattle graze in open pastures where they are frequently exposed to contaminated feed, water, and grazing areas, increasing their risk of infection [2,4]. These infections cause considerable economic losses, including reduced live weight gains, which in turn lower the market value of livestock, along with decreased milk yield, increased veterinary costs, and, in severe cases, animal mortality [7]. However, accurate and up-to-date epidemiological data on gastrointestinal parasitic infections, especially in Indonesia, remain scarce. In regions such as East Java, where cattle farming is widespread, little is known about how parasitic infections correlate with husbandry practices, environmental conditions, and host factors such as age and sex [4]. This lack of data hampers the implementation of evidence-based strategies for parasite prevention, control, and treatment.

In Indonesia, common gastrointestinal parasites include protozoa and helminths. Protozoan parasites, such as *Eimeria* spp., are highly pathogenic and often resistant to standard treatments [8,9]. Helminths, including strongyles (*Haemonchus*, *Oesophagostomum*, *Trichostrongylus*) and *Toxocara vitulorum*, are well-adapted to tropical climates and may cause both localized gastrointestinal damage and systemic effects, such as anemia and immune suppression [10]. Animals raised under traditional and semi-intensive systems are particularly vulnerable due to poor sanitation, irregular deworming programs, and limited access to veterinary services [11]. While light infections often go unnoticed, moderate to heavy infestations can result in diarrhea, weight loss, stunted growth, reduced fertility, and even mortality [12,13].

The economic implications of gastrointestinal parasitic infections are considerable. In Indonesia, gastrointestinal nematode infections alone are estimated to cost farmers over four billion rupiah annually in lost productivity [14]. Globally, the burden is even more substantial, with countries like Mexico reporting annual losses of USD 1.4 billion due to parasitic diseases [15], Brazil estimating losses of USD 65.5 per infected cow [16], and a worldwide loss of USD 400 million attributed to coccidiosis caused by *Eimeria* species [9]. Contributing risk factors include infrequent manure removal, poor drainage systems, high humidity, overcrowded conditions, and insufficient sunlight exposure, all of which create favorable environments for parasite development and transmission [17–20]. These conditions align with the classical epidemiological triad of host, pathogen, and environment, emphasizing the complexity of parasite-host-environment interactions in cattle farming [21,22].

Gastrointestinal helminth infections continue to be a persistent concern in cattle production, with varying prevalence influenced by factors such as animal age, environmental hygiene, and management practices [5]. A previous study in Laren District reported a 37% prevalence of gastrointestinal helminth infections in beef cattle, identifying seven nematode species: *Oesophagostomum* sp., *Mecistocirrus* sp., *Bunostomum* sp., *Trichostrongylus* sp., *Cooperia* sp., and *Trichuris* sp., with the highest infection rates observed in cattle aged 7–24 months and no significant differences between Peranakan Ongole and Simmental breeds [23]. In contrast, another study conducted in Tikung District found a substantially lower prevalence, with only 6% of samples testing positive for nematode eggs and 2% for cestode (*Taenia saginata*) eggs, attributed to better livestock management and higher standards of hygiene [24]. These findings emphasize the need for updated, region-specific data on the prevalence and risk factors of gastrointestinal parasitic infections in Indonesia. Therefore, this study was designed to determine the prevalence and intensity of gastrointestinal parasite infections in cattle in Lamongan Regency, East Java, and to explore associations with host age, sex, and farm management practices. The results are expected to inform evidence-based control strategies aimed at reducing parasitic burdens, enhancing cattle health, and improving overall livestock productivity.

2. Materials and Methods

2.1 Study Area

The study was conducted in Lamongan Regency, East Java, Indonesia (Fig. 1), on a small-scale cattle farm, a region with a tropical climate and extensive cattle farming. The study period was from October to November 2023, coinciding with the onset of the rainy season. Laboratory examinations were performed at the Protozoology Laboratory, Department of Veterinary Parasitology, Faculty of Veterinary Medicine, Universitas Airlangga.

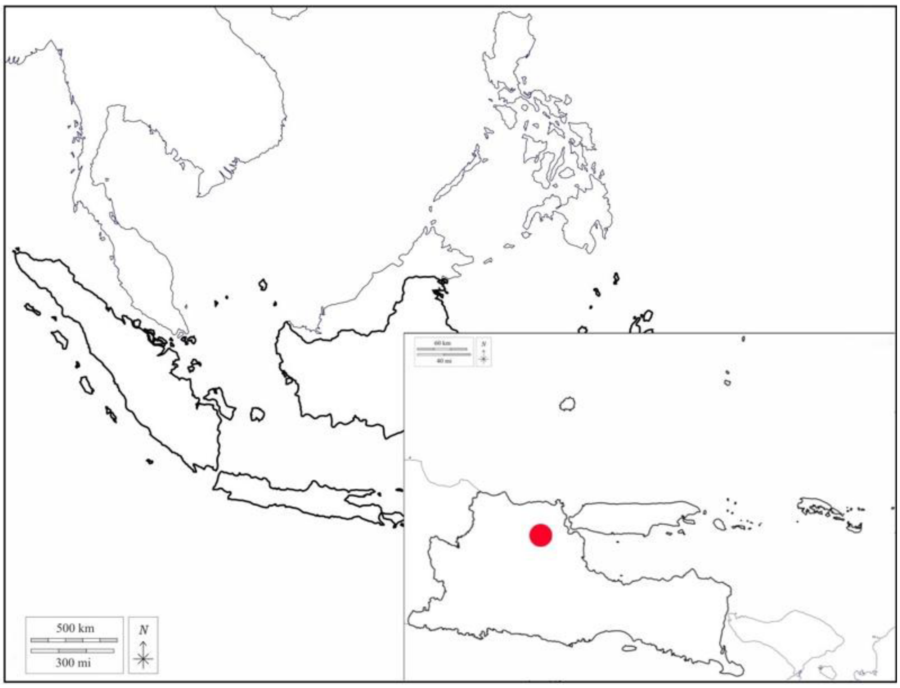

Figure 1. Lamongan Regency.

2. 2 Samples Collection

The study protocol was reviewed and approved by the Ethics Committee of the Faculty of Veterinary Medicine, Airlangga University (Ethical Clearance Certificate No. 1.KEH.167.12.2022) before the commencement of the research. A total of 120 fresh fecal samples were collected from smallholder cattle farms in Lamongan Regency. Although the minimum sample size calculation indicated only 100 samples, additional samples were collected to increase the robustness and representativeness of the data, as well as to anticipate possible sample loss or laboratory errors. Each sample was obtained from a different animal and collected directly from the rectum using disposable anal gloves. Samples were stored in labeled plastic containers containing 10% formalin for preservation and transported in a refrigerated container to the laboratory.

Sampling design considered three age groups namely: Group 1: 40 samples from cattle aged 0–1 year (20 males, 20 females), Group 2: 40 samples from cattle aged 1–2 years (20 males, 20 females), and Group 3: 40 samples from cattle older than 2 years (20 males, 20 females)

At the time of sampling, all cattle appeared clinically healthy. Sample size was determined using the following formula [23]:

$$n = \frac{4P(1-P)}{L^2} = \frac{4(0.5)(1-0.5)}{(0.1)^2} = 100$$

Explanation:

n = Required sample size
P = Estimated prevalence (50%)
L = Accepted error level (10%)

2.3 Parasitological Examination

2.3.1 Flotation Method

Fecal samples were first examined using the simple flotation technique with saturated sugar solution. Approximately two grams of feces were placed in a centrifuge tube, mixed with distilled water, and centrifuged at 1500 rpm for five minutes. After discarding the supernatant, saturated sugar solution was added to fill three-fourths of the tube and centrifuged again. The solution was added until a convex meniscus formed, and a cover slip was placed on top. After five minutes, the cover slip was transferred to a glass slide and examined microscopically under 400× magnification. Parasites were identified morphologically based on published identification keys [24,25].

2.3.2 McMaster Method

Samples positive for gastrointestinal parasites were quantified using the McMaster technique to estimate eggs or oocysts per gram of feces (EPG or OPG). An amount of approximately 2–3 g of fecal material was homogenized by vortex with 58 ml of saturated sugar flotation solution. The suspension was then filtered, and the filtrate was used to fill the McMaster counting chamber. The chamber was examined under 100× magnification, and only parasite eggs or oocysts within the grids were counted [26–28]. The final count was calculated using the formula [29]:

$$OPG = Number\ of\ oocysts\ counted\ x\ 100$$

Explanation:

OPG = oocysts per gram of feces
The multiplication factor of 100 is derived from the volume ratio and dilution used in the McMaster method: (0.3 ml counted × 60 ml total volume) ÷ 2 g feces = 100

2.4 Data on Host and Farm Management

Data on cattle age, sex, and farm management practices, including housing, feeding, and sanitation, were collected through direct farmer interviews and field observations. This data was used to assess potential risk factors related to parasite infection.

2.5 Data Analysis

Prevalence was calculated as the proportion of infected animals out of the total sample size. Descriptive statistics were used to summarize data based on age group, sex, and farm management practices. No inferential statistical tests were performed due to the descriptive design of the study.

3. Results

3.1 Parasite Identification and Prevalence

Out of 120 fecal samples examined, 78 (65%) tested positive for gastrointestinal parasites. The identified parasites comprised nematodes (*Strongylus* sp., *Haemonchus* sp., *Toxocara vitulorum*, *Trichuris* sp., *Capillaria* sp., *Oesophagostomum* sp.), cestodes (*Moniezia* sp.), and protozoa (*Eimeria* sp.). Table 1 summarizes the identification of gastrointestinal parasites with an overall infection rate of 65% (78/120). Morphological identification of parasite eggs was conducted using light microscopy at 400× magnification, as illustrated in Figures 2 and 3. These figures provide a clear visualization of key morphological characteristics, including shape and size, which are critical for accurate parasite identification and diagnosis. Accurate morphological diagnosis is essential for implementing effective control strategies.

Table 1. Identity and prevalence of gastrointestinal parasites in cattle from Lamongan Regency, East Java, Indonesia (n = 120).

Type	Parasites	Percentage (%)
Helminth	*Capillaria* sp.	4.16
	Haemonchus sp.	5.83
	Moniezia sp.	10.00
	Oesophagostomum sp.	22.5
	Strongylus sp.	16.66
	Toxocara vitulorum	9.16
	Trichuris sp.	10.83
Protozoa	*Eimeria* sp.	30.00

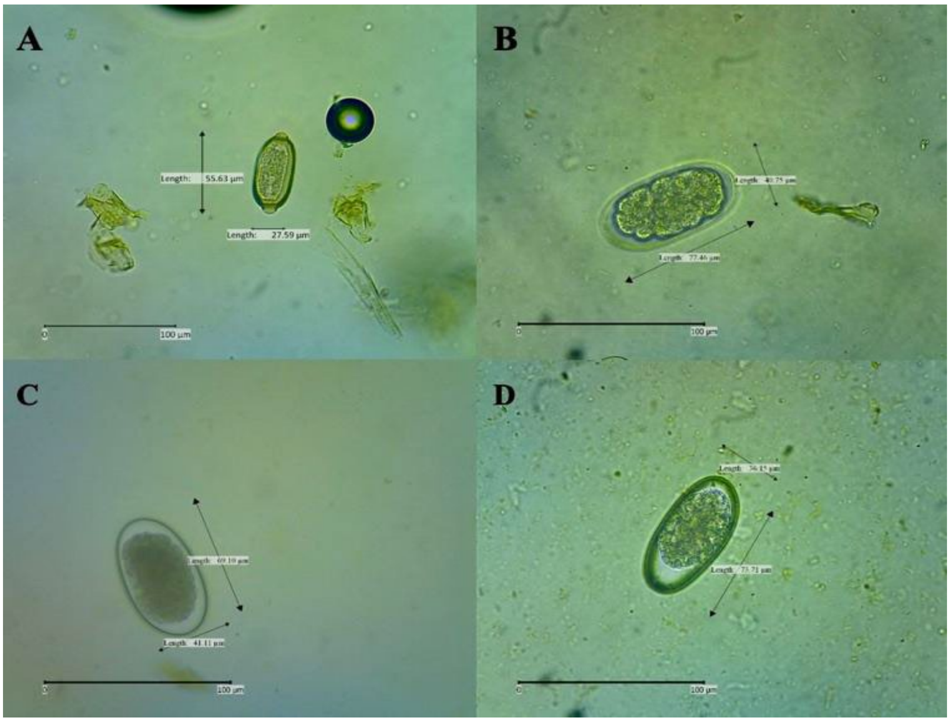

Figure 2. *Capillaria* sp. (A), *Haemonchus* sp. (B), *Oesophagostomum* sp. (C), *Strongylus* sp. (D), (400x magnification).

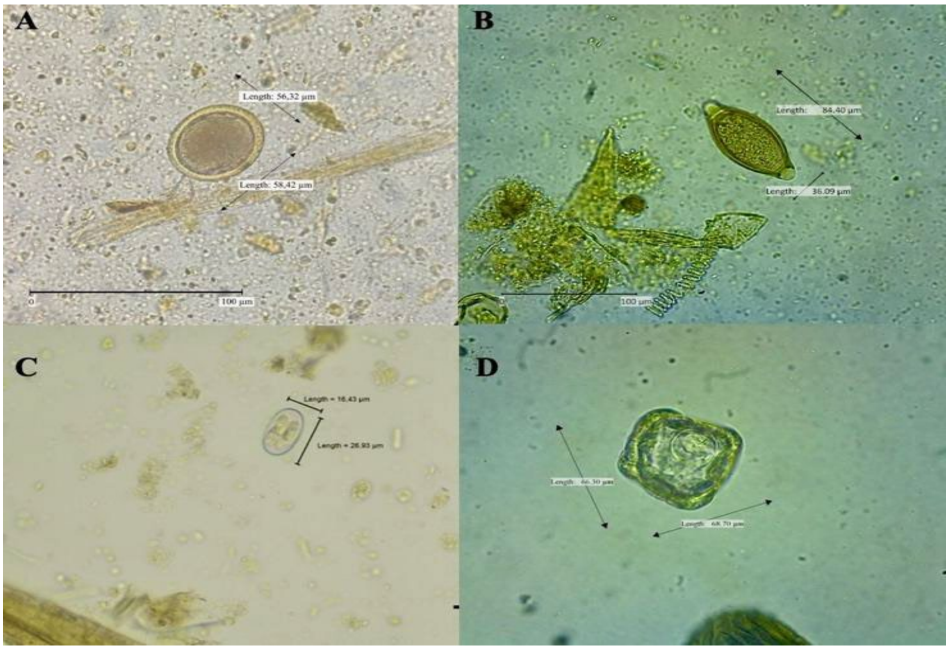

Figure 3. *Toxocara vitulorum* (A)*, Trichuris* sp. (B), *Eimeria* sp. (C), *Moniezia* sp. (D), (400x magnification).

Further analysis of parasite prevalence based on host factors, namely, sex and age, is presented in Tables 2 and 3. The data reveal a slightly higher prevalence in male cattle (33.33%) compared to females (31.66%). Regarding age, the highest infection rate was found in the youngest group (0–1 year) at 26.66%, followed by the 1–2 years group (25%), and the lowest prevalence was observed in cattle over two years old (13.33%). These findings indicate that younger cattle are more susceptible to parasitic infections, likely due to

Table 2. Prevalence of gastrointestinal parasites by age group of cattle in Lamongan Regency, East Java, Indonesia (n = 120).

Age	Prevalence (%) - middle
0-1 year (n= 40)	80.00
1-2 year (n= 40)	75.00
> 2 year (n= 40)	40.00

Note: The difference in prevalence among age groups was not statistically significant ($p > 0.05$).

Table 3. Single and multiple infections of gastrointestinal parasites in cattle in Lamongan Regency, East Java, Indonesia (n = 120).

Infection	Parasites	Number Infected	Percentage of Positive Samples (%)	Average TCPGT (EPG/OPG) ± SD
Single Infection (62/78; 79.49%)	*Capillaria* sp.	4	6.45	120.00 ± 38.73
	Haemonchus sp.	5	8.06	120.00 ± 38.73
	Moniezia sp.	5	8.06	216.00 ± 201.15
	Oesophagostomum sp.	11	17.74	138.00 ± 56.09
	Strongylus sp.	12	19.35	111.00 ± 50.13
	Toxocara vitulorum	6	9.67	197.00 ± 173.90
	Trichuris sp.	7	11.29	75.00 ± 36.74
	Eimeria sp.	12	19.35	275.00 ± 185.05
Multiple Infections (16/78; 20.51%)	*Toxocara vitulorum* *Oesophagostomum* sp. *Eimeria* sp.	2	1.67	153.00 ± 83.44
	Toxocara vitulorum *Strongylus* sp.	1	0.83	105.00 ± 36.06
	Oesophagostomum sp. *Trichuris* sp., *Eimeria* sp.	4	3.33	102.00 ± 41.55
	Haemonchus sp. *Moniezia* sp., *Eimeria* sp.	1	0.83	150.00 ± 70.71
	Oesophagostomum sp. *Moniezia* sp. *Eimeria* sp.	6	5.00	170.00 ± 67.82
	Strongylus sp. *Oesophagostomum* sp.	2	1.67	90.00 ± 84.85

underdeveloped immune systems and increased exposure to contaminated environments. Additionally, the study investigated the occurrence of single and multiple parasitic infections, as summarized in Table 4. The most common mixed infections involved *Oesophagostomum* sp., *Moniezia* sp., and *Eimeria* sp., underscoring the complexity of parasitic infestation patterns in the study area. Environmental and management factors contributing to parasite prevalence were also examined, including housing conditions, feeding

Table 4. Cattle farm management practices in Lamongan, East Java (n = 120).

Farm Management Practice Variables	Yes (n, %)	No (n, %)
Permanent housing system (cement floor, ventilation)	65 (54.2%)	55 (45.8%)
Daily cleaning of cattle housing	72 (60.0%)	48 (40.0%)
Functional drainage system in the pen	58 (48.3%)	62 (51.7%)
Clean water source (well/piped)	80 (66.7%)	40 (33.3%)
Routine provision of feed supplement (concentrate)	68 (56.7%)	52 (43.3%)
Deworming at least twice a year	44 (36.7%)	76 (63.3%)
Proper manure disposal	70 (58.3%)	50 (41.7%)
Isolation of sick cattle from healthy ones	40 (33.3%)	80 (66.7%)

practices, and hygiene standards. The findings emphasize the need for improved husbandry practices to reduce parasite transmission and mitigate the negative impacts of infection on cattle health and productivity. Overall, this study provides important epidemiological data on gastrointestinal parasites in cattle in Lamongan Regency, offering a basis for enhanced control strategies and further research.

The representative micrograph of the specimens identified in the stool samples in Figure 2 shows microscopic examination of cattle fecal samples at 400× magnification revealed the presence of various gastrointestinal nematode eggs with distinct morphological characteristics. *Capillaria* sp., eggs appeared as elongated ovals measuring 27.59–55.81 µm, with thick walls and prominent bipolar plugs resembling a cork-like structure. *Haemonchus* sp., eggs were oval-shaped (40.75–77.46 µm), possessing thin shells and multiple blastomeres, indicating an advanced embryonic stage. *Oesophagostomum* sp., eggs, ranging from 40.11–69.10 µm, were also oval and surrounded by a thin, single-layer membrane enclosing homogeneous internal contents. Meanwhile, *Strongylus* sp., eggs were elliptical (36.15–73.71 µm), with thin walls and well-organized embryonic cell clusters. These morphological features provide a reliable basis for microscopic identification of gastrointestinal parasite species in cattle.

Examination of cattle fecal samples at 400× magnification revealed a diverse range of gastrointestinal parasite eggs with distinct morphological features. *Toxocara vitulorum* eggs (Panel A) are nearly spherical, measuring 56.32–58.42 µm, with thick brownish walls and a characteristic albumin layer, and are commonly found in young calves. *Trichuris* sp., eggs (Panel B) are elongated ovals ranging from 36.09 to 88.40 µm, with thick shells and prominent bipolar plugs, serving as a distinctive trait of this genus. *Eimeria* sp., oocysts (Panel C) are round to oval, measuring 16.43–26.93 µm, with smooth, transparent walls and a color range from yellowish to colorless; these protozoa are the causative agents of coccidiosis in cattle. *Moniezia* sp., eggs (Panel D) are nearly square (66.30–68.70 µm), featuring a well-developed pyriform apparatus and a complex embryonic structure, which are characteristic of cestodes from this genus. Morphological characteristics such as shape, size, wall thickness, and internal structures are essential diagnostic criteria in differentiating parasite species. Accurate identification based on these microscopic features is crucial for developing targeted and effective parasite control strategies, thereby minimizing the health and productivity losses in cattle due to gastrointestinal parasitic infections.

Identification of gastrointestinal parasites in cattle from Lamongan Regency was carried out using the flotation and McMaster techniques. Table 1 presents only the results obtained from the flotation technique. The overall prevalence of gastrointestinal parasitic infections reached 65% (78/120), indicating a considerable burden in the sampled population. Within the helminth group, *Oesophagostomum* sp., showed the highest prevalence at 22.50% (27/120), followed by *Strongylus* sp., at 16.66% (20/120), *Trichuris* sp., at 10.83% (13/120), *Moniezia* sp., at 10.00% (12/120), *Toxocara vitulorum* at 9.16% (11/120), *Haemonchus* sp., at 5.83% (7/120), and *Capillaria* sp., at 4.16% (5/120). In the protozoan group, only *Eimeria* sp., was identified, but with a notably high prevalence of 30.00% (36/120), making it the most common gastrointestinal parasite found in this study. These findings highlight the persistent and widespread nature of gastrointestinal parasitism in cattle in the region, particularly infections caused by *Eimeria* sp., and *Oesophagostomum* sp., the high prevalence emphasizes the importance of regular monitoring and targeted antiparasitic control strategies to improve cattle health, enhance productivity, and minimize economic losses at the farm level.

The results of the analysis of gastrointestinal parasite prevalence based on sex are shown in Figure 4. Male cattle showed a slightly higher infection rate compared to females. Among the male cattle examined, 33.33% (40/120) tested positive for gastrointestinal parasites, while 16.66% (20/120) tested negative. In contrast, 31.66% (38/120) of the female cattle were positive, while 18.33% (22/120) tested negative. These findings suggest that sex-based differences, potentially related to physiological, hormonal, metabolic, and stress factors, may influence susceptibility to gastrointestinal parasitism in cattle.

The analysis of gastrointestinal parasite prevalence by age group, as shown in Table 2, reveals that the highest infection rate occurred in the youngest cattle (0–1 year), with 80% (32/40) testing positive. The 1–2 year age group exhibited

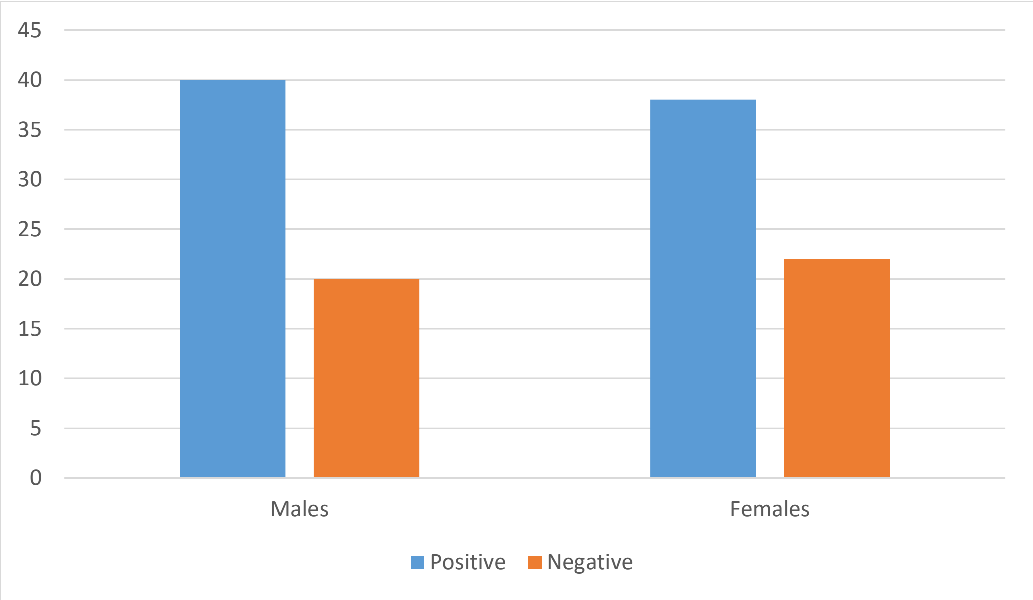

Figure 4. Prevalence of gastrointestinal parasites in cattle by sex in Lamongan Regency, East Java, Indonesia. Out of 60 males examined, 40 (66.7%) were positive and 20 (33.3%) were negative. Out of 60 females reviewed, 38 (63.3%) were positive and 22 (36.7%) were negative.

a slightly lower prevalence, with 75% (30/40) positive cases. In contrast, cattle over two years of age showed a much lower prevalence, with only 40% (16/40) infected. This decreasing trend with age may be attributed to the maturation of the immune system, which enhances the host's resistance to parasitic infections. Younger cattle are particularly vulnerable due to their underdeveloped immune responses, increased environmental exposure, and possibly suboptimal hygiene and nutrition. These findings highlight the importance of implementing targeted parasite control strategies, especially in younger cattle, to reduce infection rates and mitigate the negative effects on growth, health, and productivity.

The quantitative analysis of gastrointestinal parasitic infections using the Total Count Per Gram of Feces (TCPGT) method provided detailed insights into the infection intensity in cattle. TCPGT values, expressed as eggs per gram (EPG) for helminths and oocysts per gram (OPG) for protozoa, served as reliable indicators of parasitic load and potential health impacts. Among single infections (62/78; 79.49%), TCPGT values ranged from 75 ± 36.74 EPG for *Trichuris* sp., to 275 ± 185.05 OPG for *Eimeria* sp., The lowest count in *Trichuris* sp., reflects a relatively low egg output and likely reduced pathogenicity. In contrast, the highest value in *Eimeria* sp., indicates a considerable protozoal burden, which may predispose young cattle to subclinical or clinical coccidiosis. Other parasites demonstrated intermediate egg counts, including *Toxocara vitulorum* (197 ± 173.90 EPG), *Moniezia* sp., (216 ± 201.15 EPG), *Oesophagostomum* sp., (138 ± 56.09 EPG), *Haemonchus* sp., (120 ± 38.73 EPG), *Capillaria* sp., (120 ± 38.73 EPG), and *Strongylus* sp., (111 ± 50.13 EPG).

In mixed infections (16/78; 20.51%), average TCPGT values varied between 90 ± 84.85 and 170 ± 67.82 EPG/OPG, depending on the parasite combinations. The most frequent co-infections were *Oesophagostomum* sp., *Moniezia* sp., and *Eimeria* sp. (6/120; 5.00%), with a relatively high mean TCPGT of 170 ± 67.82, suggesting possible additive or synergistic effects. Other notable combinations included *Oesophagostomum* sp., *Trichuris* sp., and *Eimeria* sp., (3.33%; 102 ± 41.55), and *Toxocara vitulorum* with *Oesophagostomum* sp., and *Eimeria* sp. (1.67%; 153 ± 83.44). Less common cases were *Strongylus* sp., with *Oesophagostomum* sp., (1.67%; 90 ± 84.85), *Toxocara vitulorum* with *Strongylus* sp., (0.83%; 105 ± 36.06), and a unique triple infection involving *Haemonchus* sp., *Moniezia* sp., and *Eimeria* sp., (0.83%; 150 ± 70.71).

Overall, 62 of the 78 positive cases represented single infections, with *Strongylus* sp., and *Eimeria* sp., being the most prevalent (each 19.35% of positives; 12/62). These were followed by *Oesophagostomum* sp., (17.74%), *Trichuris* sp., (11.29%), *Toxocara vitulorum* (9.67%), *Moniezia* sp., (8.06%), *Haemonchus* sp., (8.06%), and *Capillaria* sp., (6.45%). Based on standard classification (mild: 1–500 EPG/OPG, moderate: 501–1,000, heavy: >1,000), all observed infections were categorized as mild, with TCPGT averages below 500. Statistical analysis (Chi-square) further revealed no significant association ($p > 0.05$) between infection intensity and either sex ($p = 0.157$) or age ($p = 0.199$). These findings suggest that although the parasitic burden in cattle was generally low, the occurrence of mixed infections and the notable contribution of protozoal parasites, such as *Eimeria* sp., may still pose risks to health and productivity, particularly in young or immunocompromised cattle.

3.2. Cattle management practices

Interviews with 120 cattle farmers in Lamongan revealed considerable variation in farm management practices Table 4. More than half of the farmers (54.2%) used permanent housing with cement floors and adequate ventilation, while 45.8% still relied on traditional housing. The majority (60.0%) reported cleaning cattle housing daily, whereas 40.0% admitted that cleaning was not performed regularly. Only 48.3% of farmers maintained a functional drainage system, with the remaining 51.7% experiencing drainage problems.

In terms of resources, 66.7% of farmers provided clean drinking water from wells or piped systems, and 56.7% regularly supplemented cattle with concentrates. However, compliance with internal parasite control was low, as only 36.7% administered deworming at least twice per year. Proper manure disposal was practiced by 58.3% of respondents, while 41.7% had not adopted appropriate waste management. The isolation of sick cattle from healthy ones was rarely implemented, with only 33.3% of farmers reporting this practice.

Overall, these findings indicate that while basic management practices, such as housing, sanitation, and the provision of clean water, were generally adopted, critical aspects, including regular deworming, drainage systems, and the isolation of diseased animals, remained weak. Such deficiencies may contribute to the persistence of gastrointestinal parasitic infections in cattle farms in Lamongan. Consistent with parasitological results, the study confirmed a relatively high prevalence of gastrointestinal parasites, predominantly *Eimeria* sp., and *Oesophagostomum* sp., although infection intensities were mostly mild based on TCPGT values. Younger cattle were more susceptible than older ones, although no statistically significant differences in infection intensity were observed between age groups or sexes. Taken together, the parasitological data and management findings suggest that inadequate husbandry practices and feeble parasite control measures may sustain infection risks. This highlights the need for integrated control strategies addressing both parasitological and management factors to improve cattle health and productivity.

4. Discussion

In the present study, the overall prevalence of gastrointestinal parasitic infections was 65% (78/120), indicating a considerable parasitic burden in the examined cattle population. Among helminths, *Oesophagostomum* sp., was the most prevalent species (22.5%, 27/120), followed by *Strongylus* sp., (16.66%, 20/120), *Trichuris* sp. (10.83%, 13/120), *Moniezia* sp., (10%, 12/120), *Toxocara vitulorum* (9.16%, 11/120), *Haemonchus* sp., (5.83%, 7/120), and *Capillaria* sp., (4.16%, 5/120). For protozoa, only *Eimeria* sp., was identified, showing a relatively high prevalence of 30% (36/120). The prevalence reported in this study is higher than previous reports from Tukung District, Lamongan (59%, 59/100) [30], Sugio District (43%, 43/100) [31], and Leces District, Probolinggo (38%, 38/100) [32], but slightly lower than the findings of Hamid in Central Java (65.93% of 455 cattle infected, with single infections reaching 79.33%) [33].

The Total Count Per Gram of Feces (TCPGT) values obtained provide a quantitative description of the infection intensity [9]. All average TCPGT values fell within the mild category (1–500 EPG/OPG), both in single and mixed infections [8,34]. Despite being classified as mild, recurrent infections, particularly with *Eimeria* sp., can still cause subclinical impacts, such as growth retardation, reduced feed efficiency, and increased susceptibility to other diseases, especially in calves

[30,35]. The highest TCPGT values were observed for *Eimeria* sp., indicating strong coccidial infection pressure in the study area. Meanwhile, nematode infections such as *T. vitulorum*, *Moniezia* sp., and *Oesophagostomum* sp., showed moderate egg counts, which, although not yet causing severe clinical disease, warrant attention to prevent environmental buildup. TCPGT is therefore a valuable tool for monitoring, evaluating treatment efficacy, and guiding risk-based control programs at the farm level.

These findings are consistent with previous reports from Java and other regions. Sari documented infections with *Oesophagostomum* sp., *Bunostomum* sp., *Mecistocirrus* sp., *Trichostrongylus* sp., *Trichuris* sp., and *Moniezia benedeni* in PO and Limousin cattle in Lamongan [30]. Similar results were noted by Paramitha in Surabaya (*T. vitulorum*, *M. digitatus*) [36], Firdayana in Makassar (*Oesophagostomum* sp., *Cooperia* sp.,) [37], and Antara *et al*. in Bali cattle (*Strongylus*-type nematodes, *Capillaria bovis*, *Strongyloides papillosus*) [38]. Age also played a key role: prevalence was higher in younger cattle (26.66% at 0–1 year; 25% at 1–2 years) and declined in cattle older than 2 years (13.33%). This aligns with Paramitha and Sari [36], as well as Khozin [12], who emphasized greater resistance in older cattle due to improved mucus secretion and immune response.

The high prevalence observed in Lamongan is strongly associated with traditional housing and management practices. Risk factors include high stocking density, poor ventilation, inadequate drainage, insufficient lighting, low-quality water sources, and limited pen cleaning, typically performed only once per day [39-41]. Such conditions favor the accumulation and spread of infective stages, while rainfall further disperses them across wider areas. Other determinants such as age, physiological status, immune competence, and population density also affect infection dynamics [42,43].

The farmer interviews conducted in this study further support the role of management practices as critical risk factors for gastrointestinal parasitism Table 4. Although most farmers adopted basic measures, such as daily cleaning and providing clean drinking water, compliance with key preventive practices remained low. Only 36.7% of farmers reported deworming cattle at least twice per year, while less than half had functional drainage systems, and only one-third practiced the isolation of sick animals. These deficiencies are consistent with previous studies highlighting that poor anthelmintic usage, inadequate drainage, and the absence of biosecurity measures contribute to the persistence of parasitic infections in smallholder cattle farms [20,44]. Strengthening farmer awareness and promoting integrated husbandry improvements, including routine deworming and proper waste and drainage management, are therefore essential to reduce parasite transmission and sustain cattle productivity.

Proper housing systems are essential to reduce parasite transmission. Well-designed and well-maintained housing minimizes exposure to contaminated soil, water, and bedding, while improving animal health and productivity [21,26]. However, infections can persist in intensive systems if hygiene is neglected. For example, Moniezia infections have been reported in housed cattle due to oribatid mites surviving in moist bedding materials, which act as intermediate hosts [36]. Therefore, housing hygiene should be integrated with comprehensive and strategically timed deworming programs. Anthelmintic administration before the grazing season and after peak exposure can interrupt parasite life cycles and reduce environmental contamination, providing a sustainable approach to parasite control [2].

Environmental factors such as temperature, humidity, rainfall, and pH critically influence parasite survival and transmission dynamics [45,46]. In this study, sampling was conducted during the rainy season, when humidity and moisture levels were high, conditions that generally favor the survival and development of gastrointestinal parasite eggs and larvae. High moisture combined with moderate pH supports the proliferation of infective stages, while cooler and wetter conditions can prolong their viability [13,34]. Conversely, extremely high temperatures under dry conditions can reduce parasite survival through accelerated metabolic exhaustion. Understanding these environmental determinants is therefore essential for epidemiological surveillance and helminth management [47-49].

Even low-level infections require timely interventions. Persistent gastrointestinal parasites are best addressed through integrated control strategies that combine improved housing hygiene, environmental management (e.g., drainage improvement and rotational grazing), and strategic anthelmintic treatment tailored to local parasite species [50-52]. Administering anthelmintics before the grazing season and after peak exposure periods can break parasite life cycles, reduce reinfection risks, and support sustainable livestock productivity.

Finally, Chi-square analysis revealed statistically significant associations, confirming the influence of the investigated variables. These findings are consistent with Sari [36], who also reported significant associations between age and gastrointestinal helminth infections in PO and Simmental cross cattle. Future research should incorporate molecular diagnostic techniques (e.g., PCR, qRT-PCR, LAMP) to enhance species-level identification and evaluate the pathogenic potential of these parasites. Furthermore, integrating farmers' knowledge, attitudes, and practices into research will provide deeper insights into behavioral factors that influence parasite control and overall cattle productivity.

4. Conclusions

This study provides an updated overview of the prevalence of gastrointestinal parasites in cattle from Lamongan Regency, East Java, Indonesia, with an infection rate of 65% (78/120). The identified parasites included *Capillaria* sp., *Haemonchus* sp., *Moniezia* sp., *Oesophagostomum* sp., *Strongylus* sp., *Toxocara vitulorum*, *Eimeria* sp., and *Trichuris* sp., with infection intensity generally classified as mild (TCPGT 1–500). The most frequently detected species were *Strongylus* sp., and *Eimeria* sp., Age was found to be a significant factor influencing prevalence, with younger cattle (0–1 year) showing higher infection rates compared to older cattle (>2 years). These findings emphasize the need for more effective parasite control strategies, particularly in young cattle, to prevent negative impacts on health and productivity. Practical recommendations include improved housing sanitation, regular fecal examinations, and targeted anthelmintic administration. Future studies should employ molecular diagnostic tools to strengthen species-level identification and monitor potential anthelmintic resistance. Additionally, integrating farmers' knowledge, attitudes, and practices (KAP) into research will support more effective interpretation and intervention planning.

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