Prevalence of Gastrointestinal Helminths in Ducks (*Anas platyrhynchos domestica*) in Bali, Indonesia

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ABSTRACT

Helminth infections of the digestive tract in ducks (*Anas platyrhynchos domestica*) can cause significant economic losses, as they can lead to growth disorders, decreased egg production, and death in the case of severe infections. This study aimed to determine the prevalence and risk factors of digestive tract worms infecting ducks in Bali, Indonesia, through post-mortem examination. A total of 200 Balinese ducks (3–12 months) were examined post-mortem, obtained from six districts in the province of Bali using random sampling. The ducks were necropsied, and their digestive tracts and livers were sampled to identify the presence of the worms. The worms were collected and fixed in aceto-acetic-formalin-alcohol solution, stained with Carmine, and identified based on morphology. The relationship between the district origin, sex, and age of ducks and the infection of each helminth was analyzed using the chi-square test. The results showed that 83.5% (167/200) of ducks were infected with worms, consisting of 78.5% trematodes, 27% cestodes, and 15.5% nematodes. The identification of trematodes revealed 12 genera, including *Hypoderaeum* spp. (41%), *Protechinostoma* spp. (16%), *Paramonostomum* spp. (14%), *Cotylorus* spp. (13.5%), *Apatemon* spp. (11.5%), *Notocotylus* spp. (10.5%), *Echinochasmus* spp. (10%), *Pseudapatemon* spp. (6%), *Echinostoma* spp. (5%), *Methorchis* spp. (5%), *Parorchis* spp. (2.5%), and *Catatropis* spp. (3%). The cestodes found belonged to three genera, including *Hymenolepis* spp. (26%), *Fimbriaria* spp. (10.5%), and *Cloacotaenia* spp. (1%). The only nematode identified was *Tetrameres* spp., with a prevalence of 15.5%. The district of origin of the ducks was associated with trematode and cestode infections, whereas the age of the ducks was associated only with trematode infections. Based on these findings, this study documented the presence of 12 genera of trematodes, 3 cestodes and one nematode in ducks from Bali, Indonesia.

Keywords: Bali, Cestode, Duck, Risk factor, Trematode

INTRODUCTION

The domestic duck (*Anas platyrhynchos domestica*) is an aquatic avian species frequently cultivated for its meat in Indonesia, including the region of Bali. In this locale, duck husbandry is often integrated with rice cultivation, wherein ducks are allowed to forage in rice paddies or rivers during the day and are housed in enclosures at night (Vipriyanti et al., 2021). The main feed for ducks consists of household organic waste, wild plants, and rice field snails, although some farmers provide additional feed in the form of pellets (Tumanggor and Suharti, 2017). Open rearing systems allow ducks to ingest a variety of feed types from their environment, which may harbor parasitic agents. Consequently, ducks are susceptible to worm infections through the consumption of contaminated feed or an intermediate host (Anggrahini et al., 2025). Free-range ducks have a greater chance of becoming infected with worms and have the potential to become vectors for the spread of worms in their environment (Rzayev et al., 2025).

Worm infections in ducks can cause various health effects, leading to significant economic losses in the poultry sector (Rzayev et al., 2021). These adverse health effects include growth abnormalities, reduced egg production, anemia, malnutrition, and increased vulnerability to other infectious diseases (Jegede et al., 2015). Furthermore, the potential for zoonotic transmission of these trematode worms represents a significant global public health concern. The zoonotic nature of trematode worms found in ducks can adversely affect human health. Therefore, it is essential to identify particular worm species and understand their prevalence to effectively reduce the risk of transmission to humans and other animals (Rzayev et al., 2021; Aurandini et al., 2024).

Various studies in different countries have documented the diversity of gastrointestinal worm infection in ducks. For example, a report from Bangladesh reported two trematodes, two cestodes, and one nematode (Begum et al., 2019). In addition, one of the most species-rich reports comes from Azerbaijan, where 27 species of parasitic helminths have been found in domestic waterfowl (geese and ducks), with nematodes being the dominant group (13 species; Rzayev et al., 2025). Furthermore, 11 of the 89 cestode species have been reported to infect domestic ducks (Rzayev et al., 2021). In Indonesia, reports of gastrointestinal worm infections are dominated by nematode infections, whereas trematode infections are limited (Anggrahini et al., 2025).

A recent investigation conducted in Yogyakarta Province, Indonesia, identified a 51.24% prevalence of gastrointestinal worm infections in ducks, as determined by the analysis of 201 fecal samples. The worms identified were *Capillaria* spp., *Trichostrongylus* spp., *Tetrameres* spp., *Syngamus trachea*, *Trichuris* spp., *Ascaridia galli*, *Heterakis* spp., *Echinuria* spp., *Strongyloides* spp., *Ostertagia* spp., Cestode, and *Raillietina* spp. (Anggrahini et al., 2025). A previous study has documented the occurrence of *Ascaridia galli*, *Heterakis* spp., and *Echinostoma* spp. in Javanese ducks (*Anas javanica*) in East Java, as determined by the analysis of 135 fecal samples (Permatasari et al., 2020). *Raillietina cesticillus, Hymenolepis nana*, and *Choanotaenia infundibulum* have been identified through post-mortem examination of ducks in West Java Province (Aviola et al., 2022). Additionally, the trematode *Echinostoma miyagawai* has been reported in Aceh Province (Chai et al., 2021). Meanwhile, in Bali Province, the nematode *Tetrameres* spp. (Yulianda et al., 2023; Sewoyo et al., 2024), and the cestode *Fimbriaria* spp. (Barus et al., 2024) have been reported.

Previous epidemiological studies conducted in Indonesia have identified a range of gastrointestinal helminths in ducks, with infection prevalence rates exhibiting considerable variation. These variations are believed to be influenced by different management systems and local environmental conditions (Permatasari et al., 2020; Anggrahini et al., 2025). Nevertheless, these studies remain constrained to fecal examinations, which present challenges in accurately identifying the worm species. This is particularly true for trematodes, whose egg production viability is subject to (Morley and Lewis, 2017; Pei and Wen, 2022). In addition, comprehensive studies on post-mortem examinations to collect and directly identify worms in ducks are still limited. Therefore, this study aimed to ascertain the prevalence and assess the risk factors according to the age, sex, and origin of the ducks.

MATERIALS AND METHODS

Ethical approval

This study was approved by the Ethics Committee of the Faculty of Veterinary Medicine at Udayana University, Denpasar City, Bali, Indonesia (decision letter number B/125/UN14.2.9/PT.01.04/2020). The study was conducted in compliance with national and institutional guidelines for the care and use of animals in research.

Sample collection

This study involved ducks from extensive farms, aged between 3 and 12 months, of both sexes. Ducks were categorised based on age into young (< 6 months) and adult ducks (> 6 months). Sampling was conducted directly from farmers across six districts in Bali (Badung, Gianyar, Tabanan, Bangli, Karangasem, and Klungkung). In each district, 30-36 ducks were collected from various farmers, resulting in a total of 200 duck samples utilized in this study. The sampling process in each district was executed in stages, with each stage comprising 15-20 ducks, until the sample size reached 30–36 ducks per district. This study was conducted between January and December 2021.

Study design

This observational study employed a cross-sectional methodology to ascertain the prevalence and types of parasitic worms in ducks, with a focus on variations based on age, sex, and geographical location.

Sampling method

Farmers were randomly selected from seven districts in the region. Ducks were randomly selected from these farmers, regardless of whether they were infected or healthy. Samples were obtained through the direct euthanasia of ducks at the farm site with the consent of the livestock owner. These ducks were sourced from smallholder farms utilising a semi-intensive farming system, as opposed to commercial poultry farms. Euthanasia was performed by decapitation by researchers in accordance with animal welfare standards and ethical protocols approved by the Research Ethics Committee.

Sample examination

After the ducks were euthanised, sex determination was performed based on the widening at the base of the tracheal bifurcation in male ducks (voice box). The study method followed the procedure described by Latham and Poulin (2002), with modifications. The updated methodology involves repeatedly washing the fluid to thoroughly remove any residual impurities, ensuring that the fluid is clear, thereby enhancing the visibility of any worms present. Next, the ducks were necropsied, and the digestive tract, respiratory tract, and liver were separated. The entire digestive tract was opened and rinsed with water, and the surface layer of the intestine was scraped. The washing process was carried out by placing the rinsed and scraped intestinal wall into a 500 ml beaker and adding water until it was full. The mixture was left for approximately 15 minutes, and the liquid was slowly poured out. This washing process was performed several

times until the resulting liquid was clear. The worms were examined by pouring the sediment little by little into a Petri dish and then examined using a stereo microscope, Stemi-DV4 (Zeiss, Germany). The worms were fixed using Aceto-Acetic Formalin Alcohol (AFA) solution and stained with carmine. Cestoda and nematode worms were identified based on morphology using Soulsby's identification key (Soulsby, 1968), while trematodes were identified based on the method of McDonald (1981).

Data analysis

The data derived from the identification of parasitic worms were subjected to descriptive analysis to ascertain the prevalence (calculated as the number of infected ducks divided by the total number of ducks examined) and specific types of worms present in each organ. Inferential analysis was conducted using the chi-square (χ^2) test to evaluate the existence of a significant association between the infection rate and variables such as age category (young and adult), sex (male and female), and geographical location (six districts in Bali), with a p-value of less than 0.05 deemed statistically significant. All analyses were performed using IBM SPSS software (version 22).

RESULTS

Upon conducting a post-mortem examination of 200 ducks revealed that 83.5% (167/200) were infected with parasitic worms. The identified worms were categorized into three groups, namely trematodes, which were present in 78.5% (157/200) of the ducks; cestodes, found in 27% (54/200) of the ducks; and nematodes, observed in 15.5% (31/200) of the ducks. The study identified 12 genera of trematodes, 3 genera of cestodes, and a single genus of nematodes. Trematodes were predominantly located in the small and large intestines, except for *Methorchis* spp., which were found in the liver. Cestodes were identified in the small intestine (*Fimbriaria* spp. and *Hymenolepis* spp.) and large intestine (*Hymenolepis* spp. and *Cloacotaenia* spp.). The only nematode detected was *Tetrameres* spp., located in the proventriculus (Table 1).

The study found that the geographical district from which the ducks originated showed a statistically significant variation in the rates of trematode and cestode infections (p < 0.05). The highest rate of trematode infection was observed in Bangli District (94.3%), whereas the lowest was recorded in Gianyar District (65.6%). A comparable trend was observed for cestode infections, with the highest prevalence in Bangli Regency (42.8%) and the lowest in Gianyar Regency (12.5%). In terms of sex, no significant difference was found in the prevalence of trematode, cestode, or nematode infections between male and female ducks (p > 0.05). However, age was a significant factor, as the prevalence of trematode infection in young ducks (86%) was notably higher (p < 0.05) than that in adult ducks (68.8%). Conversely, no significant difference was observed in the prevalence of cestode and nematode infections based on age (p > 0.05; Table 2).

Table 1. Prevalence of helminth infection in Balinese ducks in Bali, Indonesia, in 2021 as determined by post-mortem examination (n = 200)

Names of parasites	Number of positive	Prevalence (%)	Predilection
Trematode	157	78.5	
Hypoderaeum spp.	82	41	Small intestine, large intestine
Protechinostoma spp.	32	16	Small intestine, large intestine
Paramonostomum spp.	28	14	Small intestine, large intestine
Cotylorus spp.	27	13.5	Small intestine, large intestine
Apatemon spp.	23	11.5	Small intestine, large intestine
Notocotylus spp.	21	10.5	Small intestine, large intestine
Echinochasmus spp.	20	10	Small intestine
Pseudapatemon spp.	12	6	Small intestine, large intestine
Echinostoma spp.	10	5	Small intestine, large intestine
Methorchis spp.	10	5	Liver
Parorchis spp.	5	2.5	Small intestine
Catatropis spp.	6	3	Small intestine, large intestine
Cestode	54	27	
Hymenolepis spp.	52	26	Small intestine, large intestine
Fimbriaria spp.	21	10.5	Small intestine
Cloacotaenia spp.	2	1	Large intestine
Nematode	31	15.5	Proventriculus
Tetrameres spp.	31	15.5	

Table 2. Prevalence of helminth infections in Balinese ducks in Bali, Indonesia, in 2021, categorized by origin (district), sex, and age

Variable	Sample size (n)	Trematode (%)	Mean ± SD	p-value	Cestode (%)	Mean ± SD	p-value	Nematode (%)	Mean ± SD	p-value
Origin of ducks (district)										
Badung	36	66.7			30.7			16.7		
Gianyar	32	65.6			12.5			12.5		
Kelungkung	35	75.0	78.12 ± 11.88	0.010*	31.3	26.56 ± 10.68	0.040*	21.9	14.60 ± 2.10	0.590
Tabanan	32	76.7			13.3			16.7		
Karangasem	35	91.4			28.6			22.9		
Bangli	30	93.3			42.9			8.6		
Sex										
Male	85	82.4	79.05 ± 4.75	0.254	30.6	27.45 ± 3.15	0.326	17.6	17.15 ± 0.45	0.744
Female	115	75.7			24.3			15.7		
Age										
Young (< 6 months)	114	86[a]	77.40 ± 12.16	0.0003*	29.8	26.55 ± 3.25	0.300	19.3	16.05 ± 3.25	0.220
Adult (> 6 months)	86	68.8[b]			23.3			12.8		

Note: SD: Standard deviation. *Indicates a statistically significant chi-square test ($p < 0.05$).

DISCUSSION

The prevalence of helminth infections in ducks in Bali, as determined in this study, was 83.5%. This prevalence is lower than that reported in Muscovy ducks from Nigeria (98.2%; Paul et al., 2015), but closely aligns with the prevalence in domesticated ducks from Nepal (81.67%; Shrestha et al., 2020). Furthermore, other studies have documented lower prevalence rates of helminth infections in ducks, such as those reported by Ola-Fadunsin et al. (2019) in Nigeria (69.67%) and India (66.93%; Borah et al., 2018). Compared to the previous study conducted in Yogyakarta, Indonesia, which reported a prevalence of 51.24% (Anggrahini et al., 2025). The prevalence of helminth infection in ducks in Bali is notably higher. The disparity in prevalence reported in Yogyakarta by Anggrahini et al. (2025) and this study arises from the methodologies employed in both investigations. Anggrahini et al. (2025) employed fecal examination, whereas this study utilized necropsy, which is unequivocally more sensitive. The variation in prevalence can be influenced by the complex interplay between the host, parasites, and environmental factors (Anggrahini et al., 2025).

Management practices, including housing and sanitation systems, significantly impact the prevalence of helminths in duck populations (Yulianda et al., 2023). For instance, a study has indicated substantial differences in the prevalence and intensity of gastrointestinal worm infections between duck populations in lowland and highland areas (Permatasari et al., 2020). These ecological differences, particularly in regions with diverse topographies, such as Bali, can create microclimates that facilitate the life cycle of specific helminths, thereby affecting infection dynamics (Anggrahini et al., 2025). The high prevalence of helminth infections in ducks in Bali can be attributed to the semi-intensive farming system employed, in which ducks are released into post-harvest rice fields to forage. Ducks that forage freely consume a diverse array of food items, including snails, which act as intermediate hosts for helminths. The density and availability of various intermediate hosts, such as snails, beetles, and ants, within the duck grazing environment can serve as vectors for the transmission of trematode and cestode worms, subsequently leading to infections in ducks (Otranto and Wall, 2024).

In the present study, 78.5% of the Balinese ducks had trematode worms, with 12 genera successfully identified (Table 1). The diversity observed within this genus corresponds with prior studies on mallards (*Anas platyrhynchos*), particularly those conducted in Poland and the Czech Republic, which indicated significant inter-country species variation. The studies have identified the following species, namely *E. miyagawai, E. revolutum, Prosthogonimus cuneatus, Prosthogonimus ovatus, N. attenuatus, Echinoparyphium recurvatum, Australapatemon minor, Apatemon gracilis, Cyathocotyle prussica, Hypoderaeum conoideum, Metorchis xanthosomus, Psilochasmus oxyurus,* and *Cotylurus cornutus* (Rząd et al., 2020). A study of local ducks in India identified seven types of trematodes, namely *E. revolutum*, *Hypoderaeum* spp., *Psiloritis* spp., *E. paraulum*, *Paramphistomum* spp., *Prosthogonimus* spp., and *Tracheophilus cymbius* (Borah et al., 2018). There are a number of reasons why ducks have a lot of different kinds of trematodes. These factors include the semi-intensive farming system commonly practiced in Bali, where ducks are grazed in post-harvest rice fields (Barus et al., 2024; Anggrahini et al., 2025). These conditions facilitate direct contact with intermediate hosts, such as snails and small fish, which often serve as reservoirs for trematode larvae, thereby increasing the risk of infection (Anggrahini et al., 2025). Ducks can become infected with trematodes by ingesting intermediate hosts containing metacercariae (Jirsa et al., 2021). In addition, the tropical environmental conditions in Bali, characterized by high humidity and abundant water sources, support the survival and development of the worm eggs and larvae (Anggrahini et al., 2025). This exacerbates the transmission of gastrointestinal parasites in duck populations (Yulianda et al., 2023). High trematode density is significantly associated with the availability of intermediate hosts, namely snails, which are more abundant in wet environments (such as rice fields) and during rainy seasons (Otranto and Wall, 2024).

This study identified 12 trematode genera in Balinese ducks from Bali, Indonesia. To the best of authors knowledge, *Echinostoma* spp. has been documented in Java (Permatasari et al., 2020), whereas *Echinostoma miyagawai* has been reported in Aceh (Chai et al., 2021). The paucity of studies on trematodes in ducks in Indonesia highlights a significant knowledge gap concerning the biodiversity, prevalence, and transmission dynamics of these parasites in local poultry populations. This knowledge gap suggests that trematode infections may have become a neglected issue in animal health in Indonesia, with their economic implications for the productivity and profitability of the national duck farming industry remaining inadequately quantified. Furthermore, specific local ecological and epidemiological factors influencing the trematode life cycle, such as the presence of intermediate hosts and environmental conditions in Indonesia, have not been thoroughly mapped. This ultimately constrains the development of effective and targeted control strategies for these pests. Additionally, attention to parasitic diseases in poultry in Indonesia often focuses on nematode or protozoan infections, while the trematode group receives less attention (Anggrahini et al., 2025).

The prevalence of cestode worms in ducks in Bali was determined to be 27%, with three genera identified (Table 1). Various other studies on ducks have reported different prevalence rates and types of cestode worms. In Egypt, El-Dakhly et al. (2020) documented a prevalence of 8.26% with five genera, namely *Raillietina* spp., *Hymenolepis* spp., *Amoebotaenia* spp., *Choanotaenia* spp., and *Cotugnia* spp. in domestic ducks. In Nigeria, Paul et al. (2015) reported a prevalence of 20.3% with two genera, *Raillietina* spp. and *Hymenolepis* spp. In India, the prevalence of cestodes was

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recorded at 44.79%, with seven species identified, including *Hymenolepis collaris* (35.78%), *Hymenolepis carioca* (35.34%), *Fimbriaria fasciolaris* (22.41%), *Hymenolepis lanceolata* (1.74%), *Raillietina tetragona* (1.29%), *Raillietina echinobothrida* (1.29%), and *Raillietina cesticillus* (1.29%; Borah et al., 2018). Meanwhile, a study of ducks in Nepal through fecal examination found a prevalence of *Raillietina* spp. of 10.83% (Shrestha et al., 2020). Variations in prevalence and worm types are influenced by the presence of the infective stage, examination methods, and the presence of intermediate hosts in areas where the ducks forage (El-Dakhly et al., 2020; Dyab et al., 2025). Free-range duck farming systems provide greater opportunities for ducks to consume various intermediate hosts such as beetles, crustaceans, and ants (El-Dakhly et al., 2020).

A previous study in Yogyakarta, Indonesia, by Anggrahini et al. (2025) only identified cestodes in local ducks without further classification. The low sensitivity of cestode identification in microscopic fecal examination is considered suspected to be the cause of this discrepancy. This is due to the similarity in the morphological characteristics of eggs between cestode genera, which has a high potential for misinterpretation and underdiagnosis. *Raillietina* spp., *Hymenolepis* spp., and *Choanotaenia* spp. worms have been identified through post-mortem examination of ducks in West Java, Indonesia (Aviola et al., 2022). In addition, *Fimbriaria* spp. has been previously reported in Bali with a prevalence of 12% in Balinese ducks (Barus et al., 2024). However, *Cloacotaenia* spp. has never been reported, making it a newly discovered genus of ducks in Bali. *Cloacotaenia* spp. and *Choanotaenia* spp. show fundamental differences in their morphology and life cycle strategies. *Cloacotaenia* spp. is characterized by a large, almost square scolex equipped with four fleshy suckers and an incomplete rostellum (Nowak et al., 2011; Hou et al., 2020), whereas *Choanotaenia* spp. has a highly specialized scolex structure for parasitic adaptation (Silva et al., 2016). The morphology of *Cloacotaenia* spp. proglottids varies depending on the host species, with new species such as *C. cygnimorbus* showing differences in testis arrangement, cirrus structure, and proglottid size (Hou et al., 2020), while the proglottid structure of *Choanotaenia* spp. supports a complex life cycle despite limited comparative documentation (Silva et al., 2016). *Cloacotaenia* spp. is known to have aquatic intermediate hosts, such as water fleas (*Ostracoda*; Nowak et al., 2011), whereas *Choanotaenia* spp. utilizes terrestrial insects as intermediate hosts, e.g., houseflies, beetles, and ants (García Cuadrado et al., 2021).

The nematode worms identified in ducks in this study were exclusively from the *Tetrameres* genus, with a prevalence rate of 15.5%. *Tetrameres* spp. preferentially inhabits the proventriculus and has been previously documented in ducks (Yulianda et al., 2023) and chickens (Sewoyo et al., 2024) in Bali. The findings of this study markedly differ from those reported by Anggrahini et al. (2025), who observed ten genera of nematodes in Yogyakarta through fecal examination, including *Tetrameres* spp. Furthermore, Permatasari et al. (2020) reported the presence of *Heterakis* spp. and *Ascaridia* spp. in ducks via post-mortem examination. The discrepancies between our findings and those of previous studies can be attributed to variations in duck husbandry practices. Permatasari et al. (2020) and Anggrahini et al. (2025) conducted their studies on ducks from farms, where the local community raised ducks for egg and meat production, allowing for more intensive husbandry. In contrast, this study focused on free-range ducks in rice fields, where they spent their time feeding. Ducks grazing in rice fields predominantly filter water and mud to consume aquatic invertebrates such as amphipods, cyclops, and arthropods. This feeding behavior results in significant and direct exposure to *Tetrameres* spp. (Colas et al., 2016). Conversely, intestinal nematodes, such as *Ascaridia galli* and *Heterakis gallinarum*, have a direct life cycle, requiring their eggs to mature and become infectious in the environment (Otranto and Wall, 2024). Ducks become infected by ingesting these infectious eggs from the environment, including soil, water, and contaminated feed (Stehr et al., 2018). Exposure to these nematodes may not be as intense and direct as exposure to the intermediate host *Tetrameres* spp.

In the present study, risk factors associated with the origin (district) and age of ducks were linked to the incidence of trematode and cestode infections, whereas sex did not exhibit a significant correlation. The district is connected to the regional topography, where varying environmental conditions influence humidity and air temperature. These diverse environments impact the distribution and population of trematode intermediate hosts, such as various snail species, as well as beetles and ants, which serve as intermediate hosts for cestode worms (Obisike et al., 2018). Several environmental factors can affect the transmission and survival of parasitic worms, including rainfall, humidity, soil and water temperature, and the availability of intermediate and definitive hosts (Dudley et al., 2015).

The frequency and severity of worm infections in ducks can be affected by several factors, including host availability, age, sex, and environmental conditions such as season and management system (Ola-Fadunsin et al., 2019; Khanum et al., 2021). This is in agreement with the study by Ola-Fadunsin et al. (2019), who stated that the prevalence of worm infections is higher in female and young ducks than in older and male ducks. In the present study, only trematode infections were more prevalent in young ducks (< 6 months) than in adult ducks (> 6 months). However, no differences in the prevalence of nematodes, cestodes, or trematodes were observed based on age.

The high prevalence of helminth infections in the present study indicates high exposure in free-range duck farming systems in Bali. These findings emphasize the importance of control measures in free-range systems using an integrated

approach that includes the implementation of good biosecurity and sanitation, environmental management, hygienic feed and drinking water, as well as breaking the parasite life cycle by controlling intermediate hosts such as insects, snails, and slugs (Abd El-Ghany, 2022). In addition, the presence of *Echinostoma* spp. in ducks in Bali, Indonesia, is concerning because they have the potential to be transmitted to humans (Ray et al., 2024). The limitation of the present study is that this post-mortem examination-based cross-sectional study only described the prevalence of helminth infection at a specific point in time. In addition, helminth identification based solely on morphological characteristics may limit the accuracy of species-level identification. Further molecular studies and phylogenetic analyses of gastrointestinal helminths may involve the *18S rRNA*, *5.8S*, *Internal Transcribed Spacer 1* (*ITS1*), or *ITS2* gene regions, as previously done in ducks and other poultry (Eslahi et al., 2024).

CONCLUSION

The prevalence of helminth infections in ducks in Bali was 83.5%, comprising trematodes (78.5%), cestodes (27%), and nematodes (15.5%). Taxonomic identification of these helminths in ducks revealed 16 genera, including 11 trematode and one cestode genus. The geographical origin of the ducks was correlated with trematode and cestode infections, whereas the age of the ducks was associated with trematode infections. Further molecular and phylogenetic studies are recommended to accurately identify worms and determine their evolutionary relationships, thereby providing insights into the origins, genetic variation, and distribution patterns of worms.

DECLARATIONS

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Ethical considerations
The authors confirm that this manuscript is an original study of the authors and is free of plagiarism, fabrication, falsification of data, duplication of publications, or other violations of scientific ethics. All presented data and information were compiled honestly, accurately, and responsibly. The authors did not use any AI tools to conduct/ prepare this study.

Authors' contributions
I Made Dwinata was responsible for the conceptualization, methodology, field sample collection, and drafting of the manuscript. Ida Bagus Made Oka contributed to data curation, statistical analysis, and validation. Ida Ayu Pasti Apsari performed laboratory examinations, parasite identification, and data visualization. I Putu Cahyadi Putra, supervised the study, conducted the data analysis, and conducted the manuscript review and editing, as well as the corresponding author duties. All authors have read and approved the final version of this manuscript.

Competing interests
The authors declared no conflict of interest regarding the publication of this study.

Availability of data and materials
The datasets generated and/or analyzed during the current study are available upon reasonable request from the corresponding author.

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