Original Article

Ecto and Endo Parasites and Their Impact on Hematological Parameters in Domestic Pigeons of Dera Ismail Khan, Pakistan

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ABSTRACT

Background: Parasitic infestations are a significant concern in avian species, particularly pigeons, as they serve as hosts for various ectoparasites and endoparasites, impacting their health and productivity. Limited data is available on the prevalence and impact of these parasites in the district of Dera Ismail Khan, Pakistan.

Objectives: This study aimed to investigate the prevalence of ectoparasites and helminths in domestic pigeons and assess their effects on hematological parameters.

Methods: A total of 150 clinically infected pigeons were examined. Ante-mortem examinations involved visual inspection of the head, neck, wings, body surface, feathers, and cloaca for ectoparasites using a magnifying lens. Endoparasites were identified through hemoparasite screening, coproscopy, and post-mortem examination of the gastrointestinal tract. Hematological parameters, including red blood cells (RBCs), hemoglobin (Hb), packed cell volume (PCV), and white blood cells (WBCs), were measured and compared between infected and healthy pigeons.

Results: The overall prevalence of ectoparasites was 90%, with *Columbicola* spp. (80.6%), *Lipeurus* spp. (59.3%), *Menopon* spp. (42%), and *Goniodes* spp. (32.6%) being predominant. Endoparasite prevalence was 75.3%, including *Ascaridia* spp. (41.3%), *Raillietina* spp. (38.6%), and *Cotugnia* spp. (10%). Female pigeons exhibited higher ectoparasite (87.6%) and endoparasite (60%) prevalence than males. Hematological analysis revealed significantly lower RBC counts, Hb levels, and PCV values ($P<0.05$) and higher WBC counts ($P<0.05$) in infected pigeons compared to healthy ones.

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Conclusion: The high prevalence of *Columbicola columbae* (80.6%) among ectoparasites and *Ascaridia* spp. (41.3%) among helminths indicates a significant parasitic burden in domestic pigeons in Dera Ismail Khan. These infestations were associated with marked hematological changes, including significantly reduced RBC count (1.8×10^6/mL), Hb levels (7.55 g/dL), and PCV values (21.01%), alongside increased WBC count (24.03/mL). These findings emphasize the urgent need for effective parasitic control strategies to safeguard pigeon health and productivity.

Keywords: *Ascaridia* spp., *Columbicola* spp., Hematology, Parasitism, Pigeons

Introduction

Pigeons are ubiquitous birds, closely related to humans, and their affiliation has been reported since 3000-5000 BC (Sari et al., 2008). Pigeons are reared for food, ornamental, and recreational purposes (Al-Barwari et al., 2012).

Pigeons serve as hosts for a large number of ectoparasites (El-Dakhly et al., 2019). These parasites feed on the host's skin, suck blood, cause irritation, damage the skin, cause restlessness, severe itching, and weight loss, reduce egg production, and worsen health as a result of being bitten by sucking or piercing the mouth area (Bush et al., 2019).

The infestation of ectoparasites, like lice (*Columbicola columbae*, *Menopon gallinae*, *Lipeurus* spp., *Goniodes gallinae*, and *Colpocephalum turbinatum*), ticks (*Argas reflexus*), and flies (*Pseudolynchia* spp.) in domestic pigeons has been documented from many countries, including Saudi Arabia, Bangladesh, Turkey, India, Iraq, and Nigeria (Laku et al., 2018; Abdullah et al., 2018; Elmacıoğlu et al., 2018; Ali et al., 2020; Rahman et al., 2021; Gajjar et al., 2022).

Pigeons also have a high prevalence of gastrointestinal helminth (GIT), and protozoan infections, similar to poultry (Adang et al., 2008). Nematodes present in pigeons are classified into *Ascaridia* spp., *Dispharynx* spp., and *Capillaria* spp. (Alkharigy et al., 2018). Severe nematode infection adversely affects the health of pigeons, causing weakness, death of young birds, weight loss, stunted growth, damage to the stomach, and reproductive abnormalities.

Cestodes require at least one intermediate host before they can complete their life cycle in birds (Kamal et al., 2020; Soomro et al., 2024). These are found in the ileum and jejunum of the definitive host and cause emaciation, growth inhibition, and digestive tract obstruction. Their larval stage (cysticercoid) is found in any invertebrate host, such as beetles, ants, and termites (Butboonchoo et al., 2016).

Blood serves as a pathological reflector, exhibiting the status of animals exposed to pathogenic organisms (Opara et al., 2012). It is a widely used health assessing tool in animals but it is less common in birds (Kral et al., 2000). Hematological variation is related to parasitism and cestode infestation results in lowered haematological values in chicken (Aade et al., 2012). Nematode and cestode infestation in domestic pigeons greatly affect total leukocytic count and haemoglobin estimation levels (Basit et al.,2006). It has also been reported that total erythrocytic count and hemoglobin (Hb) decrease, whereas total leucocytic count increases, subsequent to helminthic infestation in sparrows.

A great deal of research has been conducted on parasitic diseases of pigeons in different areas of Pakistan, but no single study has been reported in the district of Dera Ismail Khan. Therefore, the current study was planned to examine the cross-sectional analysis of ectoparasites, gastrointestinal parasites, and hemoparasites in domestic pigeons in the district of Dera Ismail Khan, Pakistan.

Materials and Methods

Study area and duration

The current study was conducted in Dera Ismail Khan District, Pakistan, at the Faculty of Veterinary and Animal Sciences (FVAS), Gomal University (GU), Dera Ismail Khan (DIK) (31° N, 70° E), for a period of six months from January to June 2024. A total of 150 (males: n=75 and females: n=75) domestic pigeons were purchased from pigeon fanciers and local markets. These were tagged according to the name of the shopkeeper and the location of the shop/fancier.

Selection and examination of birds

Prior to enrolling the birds in the current study, information about each bird was collected through owner assistance or physical examination. The birds were removed from their cages and restrained (Dranzoa et al., 1999). Age and sex were determined as previously described by Sol (2000). Birds were classified as adults or immature (yearlings) based on plumage characteristics, eye color, and cere texture; with adults showing fully developed iridescent plumage, bright orange eyes, and a more keratinized cere, while immature birds had duller plumage, brownish eyes, and a softer cere. Each bird was examined for ectoparasites, fecal parasites, and blood parasites.

Sample collection

Ectoparasites were collected through careful observation of the head, neck, wings, body surface, and cloacae of the pigeon with a magnifying lens, preserved in 70% alcohol and analyzed in the parasitology laboratory. To examine endoparasites, the fresh fecal samples were collected per rectum of the bird (Akram et al. 2019) and examined using a direct coproscopic method. Gross helminths passed in feces were also collected and identified. Lice and nematodes (*Ascaridia* spp., *Dispharynx* spp., and *Capillaria* spp.) were studied after clearing them with lactophenol. Blood samples were collected through an insulin syringe from the brachial vein catheter. Blood smears were prepared from each sample, fixed with methanol, and stained with Giemsa. After staining, the samples were examined under the light microscope at 100X magnification with oil immersion. All blood parasites were identified using the parasitological key (Soulsby, 1986).

Postmortem examination

After completing the anti-mortem examination, the pigeons were kept for post-mortem examination. The remaining ectoparasites were collected by killing pigeons through anesthesia (Soulsby, 1986). The collected ectoparasites were placed in polyethylene bags, and preserved in 70% alcohol for further identification. During postmortem, the entire alimentary tract, respiratory system, heart, liver, kidneys, and reproductive tract were examined as shown in Figure 1. The endoparasites, including nematodes and cestodes, were washed with water and preserved in 70% ethanol. Cestodes were stained with acetocarmine to facilitate the identification of morphological features and were identified using helminthological keys (Soulsby, 1986).

Hematological parameters

Hematological parameters were determined using standard methods: packed cell volume (PCV) was measured using the microhematocrit technique, Hb concentration was estimated using Sahli's method, and red and white blood cell (RBC and WBC) counts were assessed using a hemocytometer in a 1:200 dilution of blood in Natt and Herrick's solution (Joseph et al., 2023).

Statistical analysis

All analyses were performed using SPSS software, version 20. The chi-square test was employed to analyze risk factors, including gender and age. Hematological differences between infected and non-infected pigeons were evaluated using Tukey's test, with a significance level of $P<0.05$.

Results

Overall prevalence of parasites in domestic pigeons

The study examined a total of 150 pigeons, of which 113(75.3%) and 135(90%) were infected with different types of helminths and ectoparasites, respectively as shown in Table 1. *Ascaridia* spp. (41.3%) had the highest incidence of helminths, followed by *Raillietina* spp. (38.6%) and *Cotugnia* spp. (10%). On the other hand, four species of ectoparasites were found: *C. columbae* (80.6%), *Lipeurus* spp. (59.3%), *Menopon* spp. (42%), and *Goniodes* spp. (32.6%). The prevalence of *C. columbae* was found to be highest among the ectoparasites. The microscopic appearance of *C. columbae*, *Lipeurus* spp., and *Menopon* spp. is shown in Figure 2, while their eggs are shown in Figure 3.

Age-related prevalence of parasites in domestic pigeons

The overall prevalence of helminths was higher ($P>0.05$) in adults (73.4%) than in yearlings (64.8%). The individual prevalence of *Ascaradia* spp., *Raillietina* spp., and *Cotugnia* spp. in adult and yearling pigeons was 42.4%, 37.8%, and 44.2% and 21.6%, 11.5%, and 5.4%, respectively ($P>0.05$). The the overall prevalence of ectoparasites was significantly higher ($P<0.001$) in adults (94.6%) than in yearlings (62.1%). The specific prevalence rate of *C. columbae*, *Lipeurus* spp., *Menopon* spp., and *Goniodes* spp., in adult and yearling pigeons was 91.1% and 48.6%, 64.6% and 43.2%, 45.1% and 32.4%, and 34.5% and 27%, respectively. The results

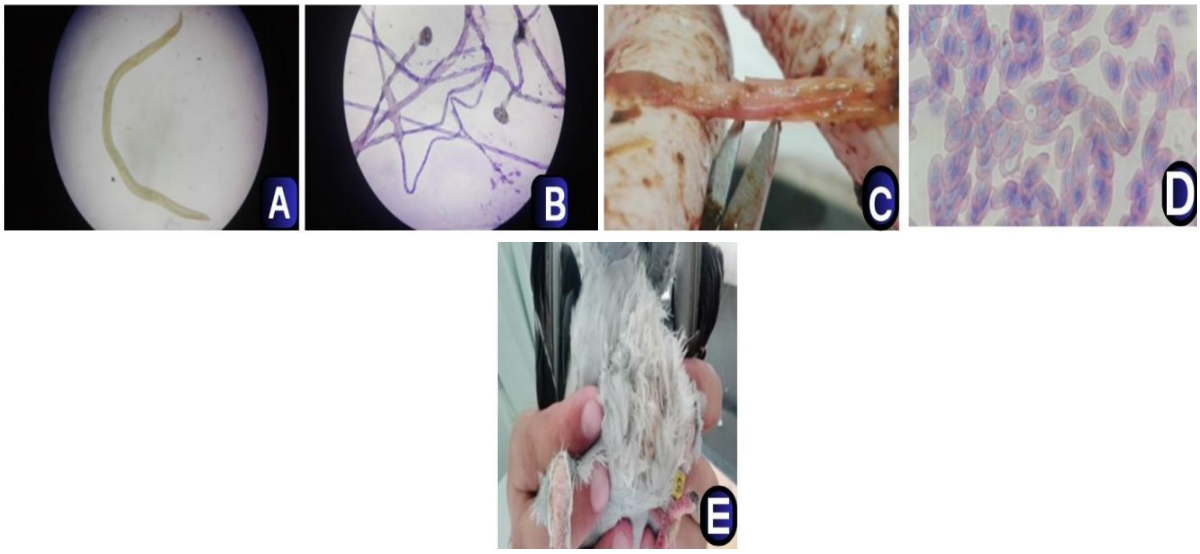

Figure 1. Microscopic appearance of (A) *Ascaridia* sp. and (B) *Raillietina* sp.; (C) Examination of internal organs during postmortem; (D) Negative blood smear; (E) Abdominal swelling due to endoparasite

showed a significantly higher prevalence of *C. columbae* and *Lipeurus* spp. in adult pigeons than in yearlings.

Sex-related prevalence of parasites in domestic pigeons

Female pigeons (60%) were more susceptible (P>0.05) to helminth infection than male pigeons (53.3%). The individual prevalence of *Ascaradia* spp., *Raillietina* spp., and *Cotugnia* spp., in male and female pigeons was 26.6% and 47.6%, 35.5% and 40%, 4.4% and 12.3%, respectively. A significant (P<0.05) sex-related difference was observed in the prevalence of *Ascaradia* spp. and *Cotugnia* spp. The overall prevalence of ectoparasites was 87.6% in female pigeons and 86.6% in male pigeons. The individual prevalence of *C. columbae*, *Lipeurus* spp., *Menopon* spp., and *Goniodes* spp. in male and female pigeons was 75.5% and 82.8%, 53.3% and 60.9%, 28.8% and 47.6%, and 20% and 38%, respectively. The prevalence of all lice studied, except *Lipeurus* spp. was higher in female than in male pigeons, (P<0.05), but this difference was not significant.

Relative hematological parameters

Hematological profiles, including WBC and RBC counts, PCV, and Hb levels were measured in infected (n=20) versus non-infected (n=20) pigeons. The RBC

Table 1. Overall prevalence of parasites in domestic pigeons in District Dera Ismail Khan (n=150)

Name of Parasites		No. of Infected Pigeons	Prevalence
Helminthes	Overall	113	75.3
	Ascaradia sp.	62	41.3
	Raillietina sp.	58	38.6
	Cotugnia sp.	15	10
Ectoparasites	Overall	135	90
	C. columbae	121	80.6
	Lipeurus sp.	89	59.3
	Menopon sp.	63	42
	Goniodes sp.	49	32.6

N=Number of bird examined.

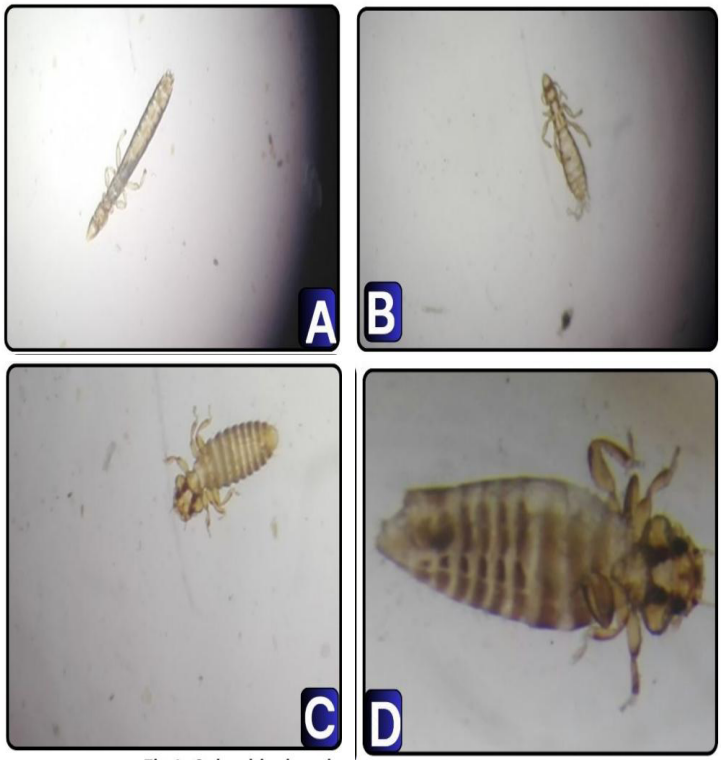

Figure 2. Microscopic appearance of (A) *C. columbae*, (B) *Lipeurus caponis,* and (C & D) *M. gallinae*

count (1.8×10^6/mL; P=0.037), Hb levels (7.55 g/dL; P=0.04) and mean PCV values (21.01%; P=0.002) were found significantly lower in infected pigeons compared to non-infected pigeons. Contrarily, the WBC count was significantly higher in infected pigeons (18.23 /mL) than in non-infected pigeons (24.03 /mL) (Table 2).

Discussion

Ectoparasites reside on the skin and feathers of their hosts, utilizing them as both shelter and a food source. These parasites have a significant impact on the health and productivity of animals. The overall prevalence of ectoparasite infestations in the current study (90%) is consistent with previous findings from Pakistan, which reported a 90.5% prevalence (Ahmed et al., 2018). On the other hand, a study reported a lower prevalence of 76% from Iraq (Issa et al., 2021). In the current study, four species of ectoparasites were identified in pigeons, whereas another study documented only two species (Walteros-Casas et al., 2021). It has been reported that lice infestation is a common problem in pigeons (Ombugadu et al., 2018).

The highest prevalence of *C. columbae* (80.6%) was recorded in the current study, a figure higher than that reported in Iraq (Issa et al., 2021). Our study also revealed a higher prevalence of *Menopon* spp. (42%) compared to findings in Nigeria at 23.33% (Edosomwan et al., 2018) and Iran at 20% (Sadeghi-Dehkordi et al., 2019). More-

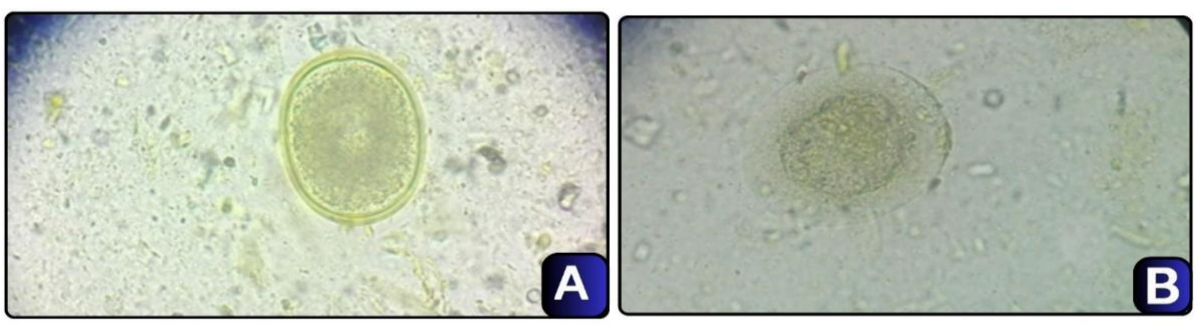

Figure 3. Microscopic appearance of the eggs of (A) *Ascaridia* spp. and (B) *Raillietina* spp.

Table 2. Hematological parameters of infected (n= 20) versus non-infected pigeons (n= 20)

Groups	Mean+SE			
	PCV	Hb	RBCs	WBCs
Infected	21.01± 3.09a	7.55±1[a]	1.80±0.11[a]	18.23±1.89[a]
Non-infected	39.09±1.11b	13.21±2.1[b]	4.01±0.23[b]	24.03±1.75[b]

Note: Values sharing different letters in each column are statistically significant (P<0.05).

over, the highest *Menopon* spp infestation rate (100%) was reported in Saudi Arabia. *Lipeurus* spp. infestation rate was 59.3% in the current study, which is slightly lower than the 61.48% prevalence reported in Bangladesh (Rahman et al., 2021). The prevalence of *Goniodes* spp. in the current study is somewhat lower than the 28% reported in Bangladesh (Ghosh et al., 2014).

The variations in prevalence observed between contemporary and earlier studies may be attributed to factors, such as differing breeding methodologies, geographical settings, study duration, sample collection techniques, and inconsistencies in identification protocols. Our study revealed that female pigeons (87.6%) were more heavily infested as compared to male pigeons (86.6%). Similar findings were reported from a previous study in Pakistan, in which female pigeons were more frequently infested with lice than males (87.95%) (Ahmed et al., 2018). Consistent data were also recorded in other research, indicating higher ectoparasite infestation in females (65%) than in males (45.5%) (Khan et al., 2021).

Regarding age, our results showed that adult pigeons were more frequently infested with ectoparasites than yearlings. These findings are in line with a previous study, which noted a significant difference in ectoparasite prevalence between adult and young pigeons (Tayyub et al., 2021). The increased exposure of adult birds to environmental pollutants may be one contributing factor to this higher infestation rate.

The overall prevalence of helminth infections in the present study (75.3%) was significantly higher than the 24.3% reported by Kommu et al. (2016). In contrast, another study reported a higher prevalence (90.83%) than that observed in our study (Sharma et al., 2021). Our findings regarding the high prevalence of *Ascaridia columbae* infections contrast with the study by Dakhly et al. (2019), who reported a high prevalence of *Raillietina* spp. A plausible reason for the frequent occurrence of nematode infections in the present study is the high resistance of their eggs to common disinfectants and their tolerance of harsh environments (Soulsby, 1982).

Our observed occurrence of *Raillietina magninumida* (38.6%) was significantly lower than the previously reported 54.5% (Chaechi-Nosrati et al., 2018). Conversely, our findings align with the prevalence of *Raillietina* spp. documented in previous research (Kommu et al., 2016). We noticed a higher prevalence of nematodes compared to cestodes. Furthermore, our findings showed a discrepancy in the prevalence of *Cotugnia cuneata* (10%) compared to the high prevalence (100%) reported in a previous study (Begum et al., 2012). The fact that soil serves as an important reservoir and transmission medium for soil-borne helminths likely contributes to a higher prevalence of such parasitic infections.

Regarding gender, the current study demonstrated a higher helminth infection rate in females (60%) compared to males (53.3%), a finding similar to that reported in Turkey (Habibu et al., 2022). In contrast to the present study, a higher helminth infection rate in males than in females has been reported in Iraq (Issa et al., 2021). Although the precise cause of the high prevalence of helminths in female pigeons has not yet been specified, it may be suggested that hormonal variation and stress affect the immunity of female pigeons, potentially leading to higher rates of parasitism in females compared to males.

In the current study, it was established that age influences the prevalence of helminth parasites in pigeons. Adults showed a higher prevalence (73.4%) than yearling pigeons (64.8%), which aligns with results from previous studies (Sivajothi et al., 2015; Rahman et al., 2021).

The findings of this study are in close agreement with a previous study on chickens, which reported lower total erythrocytic counts in birds with ectoparasitic and endoparasitic infestations (Wamboi et al., 2020). Likewise, another study documented that hematological variations are related to parasitism and reported lowered hematological values in cestode-infested chickens (Aade et al., 2012). Additionally, our findings are supported by a previous study reporting that nematode and cestode in-

festations in domestic pigeons significantly affect total leukocytic counts and Hb levels (Basit et al., 2006). Furthermore, it has been established that total erythrocytic count, and Hb levels decreased, while total WBC counts increased, in cases of helminthic infestation in sparrows (Khan et al., 2006). On the contrary, our study disagreed with the findings of previous findings (Opara et al. 2012; Omonona et al. 2017) reporting no significant difference in the hematological parameters of pigeons infested with gastrointestinal parasites.

Conclusion

This study was an attempt to collect empirical information regarding ectoparasites and endoparasites in pigeons within the Dera Ismail Khan District of Pakistan, specifically examining variations in parasite prevalence in relation to age and sex. Seven species of both ectoparasites and endoparasites were identified: *Columbicola* spp., *Menopon* spp., *Lipeurus* spp., *Goniodes* spp., *Cotugnia* spp., *Ascaridia* spp., and *Railletinia* spp. It results revealed that age and sex of pigeons had a significant ($P<0.05$) effect on the prevalence of ectoparasites and intestinal helminths. Furthermore, all examined pigeons tested negative for hemoparasites. RBC, Hb, and PCV values were significantly lower in infected birds compared to healthy birds, whereas WBC counts were significantly higher in infected birds. It is recommended to conduct further studies on pigeon health and production to assist clinicians and raise awareness among farmers regarding appropriate preventative measures. In conclusion, parasitic infestation is a major challenge for pigeon farming in this region; therefore, specific precautions must be implemented to manage parasitic infections in farmed pigeons.

Ethical Considerations

Compliance with ethical guidelines

All procedures were performed by qualified, licensed veterinarians. This study strictly adhered to international, national, and institutional guidelines for animal care and use.

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Authors' contributions

Conceptualization: Asfand Yar Khan, Muhammad Muneeb, Mustofa Helmi Effendi, and Muhammad Zeeshan Shabbir; Methodology, project administration and resources: Asfand Yar Khan; Formal analysis: Asfand Yar Khan, Muhammad Muneeb, Iqra Naeem, Muhammad Zeeshan Shabbir, Muhammad Faheem and Umer Farooq; Data curation: Muhammad Muneeb, Asfand Yar Khan, and Muhammad Ishtiaq; Investigation, software, visualization, validation, and writing: Asfand Yar Khan and Muhammad Muneeb; Funding acquisition: Mustofa Helmi Effendi and Asfand Yar Khan; Supervision: Mustofa Helmi Effendi.

Conflict of interest

The authors declared no conflict of interest.

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