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Gastro-intestinal parasites in free ranging Rhesus Macaque (*Macaca mulatta*) in Tarai region of Uttarakhand, India

Deepesh Sharma, Stuti Vatsya, Rajeev Ranjan Kumar and Sudhir Kumar

Abstract
The present study aimed to evaluate parasitic load among the monkeys in order to assess the threat of parasitic transmission to humans since they act as a potential source of parasitic zoonoses. In the present study, faeces of 52 Rhesus monkeys (*Macaca mulatta*) were collected from different tarai region of Uttarakhand. These faecal samples were brought to the laboratory of Department of Parasitology, College of Veterinary & Animal Sciences, Pantnagar and examined for the presence of parasitic eggs and cyst using qualitative and quantitative methods of faecal examination. Out of 52 faecal samples of monkeys, 37 (71.15%) were found positive for one or mixed parasitic infection. The study revealed that the monkeys were infected with 7 genera of parasites i.e. *Trichuris* sp. (23.07%), *Hymenolepis* sp. (5.76%), *Strongyloides* sp. (13.46%), *Ancylostoma* sp. (19.23%), *Entamoeba* cyst (26.92%), *Ascaris* sp. (7.69%), Strongyle eggs (13.46%) and unidentified cestode egg (17.30%). The multiplicity and frequency of various parasites were observed in faeces of monkeys collected from nearby areas of human habitats suggest that these parasites can pose a high risk of its transmission to human population and thus are of considerable public health importance.

Keywords: Monkey, parasitic zoonoses, gastro-intestinal parasites

Introduction
India is rich in primate fauna. There are about 20 species of non-human primates in India out of 200 found in the Earth. Non-human primates (NHP) prefer to live in mixed evergreen forests but due to continuous deforestation and conversion of these forests to pine forest, NHP's have adapted themselves to lives in human landscape (Pirt *et al.* 1990) [10]. Due to their change in habitat their conflicts with man are increasing. Though they are our closest living creatures on Earth, hence they are able to transmit many zoonotic diseases to humans (Vitazkova and Wade 2007) [16]. Habitat fragmentation and tourism facilitate the transmission of parasitic infections from NHP's to humans and vice versa (Goldberg *et al.* 2008 [5]; Kowalewski *et al.* 2011) [7]. McGrew *et al.* 1989 reported that primates living nearby to human habitat were more intensely infected with gastrointestinal parasitic infection as compared to those living in forest. Under natural conditions, NHP living in captive as well as in free ranging populations are frequently infected with gastrointestinal parasites. NHP act's as a reservoir of many parasitic agents and hence are causing threat to public health (Gillepse *et al.* 2008) [4]. There are few reports regarding the prevalence of gastrointestinal parasites of NHP in India

Material and Methods
Study area and sampling
The present study work was conducted at different parts of tarai regions (29^0N and 79.30^0E; 550mt above sea level) of Uttarakhand, India. Faeces of 52 Rhesus monkeys (*Maccaca mulllata*) were collected from domestic places and agricultural fields from February 2019 to July 2019.

Collection and examination of faecal samples
Samples were collected immediately after defecation and surface of each sample was taken by spatula to avoid possible contamination from ground and kept in 50ml Falcon tubes having 10% formalin (Martin-Solano *et al.* 2017)[8]. Samples were directly taken to the laboratory of Department of Veterinary Parasitology, Pantnagar for further screening. In the laboratory,

endoparasite eggs and cysts were isolated from the faecal samples by direct smear and floatation concentration techniques (Gillespie, 2008)[4]. Parasitic eggs and cyst were identified up to the generic level using the key of Chatterjee (1967) [2], Soulsby (1982) [14] and Zajac & Conboy (2012) [17].

Prevalence study

The prevalence (P) of infection was calculated according to Thrusfield (2007) [15]:

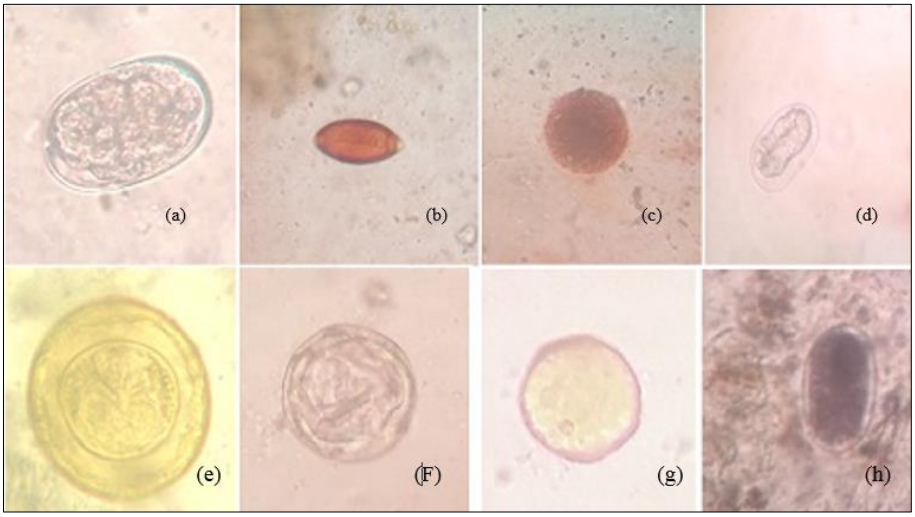

Fig 1: Different species of parasitic eggs and cyst recovered from macaque faeces. (a) *Ancylostoma* sp. egg (40X); (b) *Trichuris* sp. egg (10X); (c) *Ascaris* sp. egg (40X); (d) *Strongyloides* sp. egg (40X); (e) *Hymenolepis* sp. egg (40X); (f) Cestode egg (40X) unidentified; (g) *Entoamoeba* sp. cyst (40X); (h) Strongyle egg (10X).

Table 1: Overall percent prevalence of gastro-intestinal parasitic infection in monkey

S. No.	Parasites	Sample positive	Prevalence (%)
1.	*Trichuris* sp.	12	23.07
2.	*Ancylostoma* sp.	10	19.23
3.	*Ascaris* sp.	4	7.69
4.	*Strongyloides* sp.	7	13.46
5.	*Hymenolepis* sp.	3	5.76
6.	Cestode egg (unidentified)	9	17.30
7.	*Entamoeba* sp. cyst	14	26.92
8.	Strongyle	7	13.46
Total	Positive	37	71.15

N=52 (Total samples examined)

Table 2: Gastro-intestinal parasitic infection status in monkeys

S. No.	Infection status	Parasite Present[a] %	infection
1.	Single infection	St (7/52); Tri (3/52); As (2/52); Ent (3/52); Ancy (2/52); Stro (2/52)	38.46% (20/52)
2.	Double infection	Ancy+ Cest (1/52); Ent+ Cest (2/52); Ent.+ Ancy (4/52); Ancy+ Tri (2/52); Ent+Tri (1/52);Tri+Cest(1/52); Ent+Stro(1/52);Tri+Cest(1/52); Tri+Stro(1/52)	26.92% (14/52)
3.	Mixed infection	Ent+Ancy+Stro+Cest+Hy+Tri (1/52) Ent+Stro+Cest+As+Hy+Tri (2/52)	5.76% (3/52)

[a] St=Strongyle; Tri=*Trichuris* sp.; As=*Ascaris* sp.; Ent= *Entamoeba* sp.; Cest= Unidentified Cestode; Ancy= *Ancylostoma* sp.; Stro= *Strongyloides* sp.; Hy= *Hymenolepis* sp.

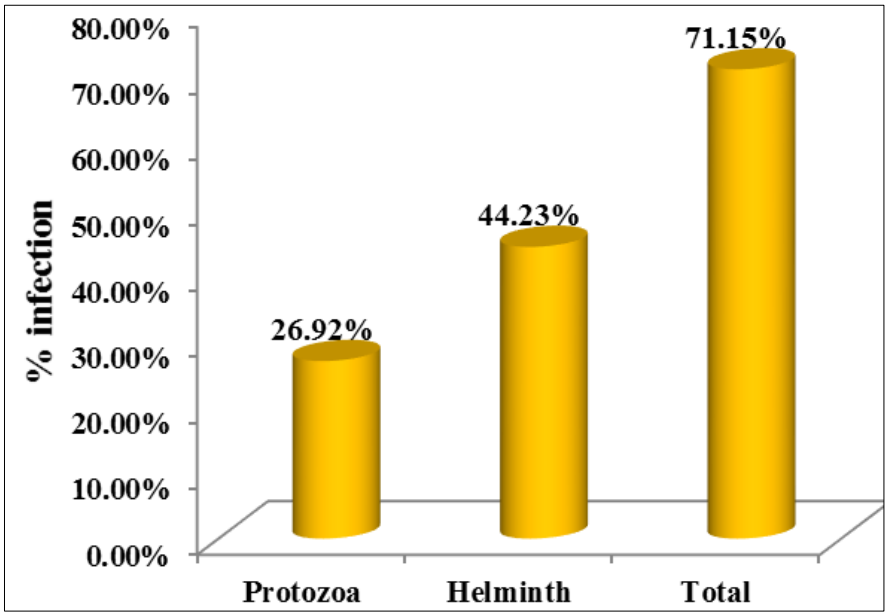

Fig 2: Overall prevalence of parasitic infection

Ethical statement

The samples examined in the present study were collected after defecation of free ranging macaques present in their habitat and during sample collection neither animal were harmed nor disturbed.

Results

In the present study, out of 52 faecal samples of Rhesus Macaques (*Macaca mulatta*), 37 were found to be infested with one or more species of gastro intestinal parasite. The monkeys were infected with seven genera of parasites of which five are of nematodes (*Trichuris* sp., *Strongyloides* sp., *Ancylostoma* sp., *Ascaris* sp., Strongyle), one of protozoa (*Entamoeba* sp. cyst) and two of cestodes (*Hymenolepis* sp. and other were unidentified) as shown in Figure 1. The overall prevalence of parasitic infection in free ranging monkeys was 71.15%. In the present study, the prevalence of helminth infection (44.23%) was found higher than protozoa (26.92%) infection as shown in Figure 2. Among the infected monkeys highest prevalence of gastrointestinal parasite was detected for *Entamoeba* cyst (26.92%), followed by *Trichuris* sp. (23.07%), *Ancylostoma* sp. (19.23%), unidentified cestode eggs (17.30%), *Strongyloides* sp. (13.46%), Strongyles (13.46%), *Ascaris* sp. (7.69%) and *Hymenolepis* sp. (5.76%) as shown in Table 1. In the present highest prevalence of single infection (38.46%) were observed by double infection (26.92%) and mixed infection (5.76%) as shown in Table 2.

Discussion

The overall prevalence of parasitic infection in monkeys was similar with the findings of Rondon *et al.* (2017) [13], Adhikari & Dhakal, (2018) [1], Pokhrel and Maharjan (2014) [11] as 72.90%, 74.20% and 72.94% respectively. High prevalence of infection may be due to habits of NHP of eating food and water from grounds, dustbins and from sewage canals nearby the human communities. They may also get infection after soaking water food present in tree holes. In the present study, prevalence of helminthes was high than protozoa which may be due to the source of feeds, geographical conditions and feeding behavior of macaques. Davis and Pederson, 2008[3] documented that protozoan infection was low due to host susceptibility or behavior. Adhikari and Dhakal (2018) [1] also reported more prevalence of helminth parasites (52.68%) than protozoa infection (40.86%). In helminth, *Trichuris* sp. was found most prevalent than other helminthes which was similar with the findings shown by Adhikari and Dhakal (2018) [1], Pokhrel and Mahajan (2014) [11] and Huffman *et al.* (2013) [6]. Roberts and Janovy, 2000 [12] reported that in NHP prevalence of *Trichuris* sp. was high, since it existed in warm moist, wet soil and low light climatic condition in tropical and temperate areas.

Conclusion

High level of infection in monkeys may be due to deforestation as many troops of monkeys lives in the same community and causes exchange of infection between them. Change in behavior and feeding habits of monkeys of living within the human societies causes switching over of infection between them. The result suggested that the variety of parasites recovered from the faecal droppings of monkeys collected from domestic habitats can create human population more vulnerable to parasitic zoonoses and may thus be of major public health importance. The multiplicity and frequency of various parasites were observed in faeces of monkeys collected from nearby areas of human habitats suggest that these parasites can pose a high risk of its transmission to human population and thus are of considerable public health importance.

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