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Prevalence of Parasites of Nile Tilapia (*Oreochromis niloticus)* and African Big Barb (*Labeobarbus intermidus)* Fish in Gigel Gibe-I Dam, Jimma Zone, Ethiopia

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Abstract: This study was conducted from October, 2015 to August, 2016 with the objective of identifying the major parasites of *Oreochromis niloticus* and *Labeobarbus intermedius* to the lowest possible taxa, quantitatively determining the prevalence, mean intensities and mean abundances of parasites. A total of 768 fish (384 *O. niloticus and 384 L. intermedius)* were examined using necropsy and parasitological examination procedures for the presence of parasites. Both fish species were found infected by three genera of Digenean, two genera of nematoda, two genera of crustacean, two genera of monogenean, unidentified cestodes and leech. The overall prevalence of internal parasites of both fish species was 80%. The prevalence of parasites in *O. niloticus* was found to be 98.43% and that of *L. intermedius was* 61.71%. There was statistical significant difference ($p<0.05$) between the two fish species in overall prevalence of the parasite infestations. However, the difference in prevalence of parasites among sex and seasons was not statistically significant ($p>0.05$). The condition factor of the fish infested by different fish parasites was not affected but it was positively correlated with parasite intensities. The prevalence rate and mean intensities of the parasites is high especially in *O. niloticus* and needs to design control strategies especially when fingerlings from the dam is used to stock other water bodies and intensive and small scale aquaculture farms.

Key words: Gilgel Gibe-I · Intensities · Fish · Parasites · Prevalence

INTRODUCTION

The Ethiopian fisheries sector contributes to the gross domestic product (GDP) and thus plays an important role in the national economy. Fishing as an economic activity earns people a living, provides protein food, employment, job opportunities, fish traders, fish processors and fish farmers [1]. Parasites are important components of host biology, population structure and indeed ecosystem functioning. They can be found in any fish species and within any type of aquatic and culture system. They range from protozoans such as flagellates, ciliates and apicomplexans to metazoans including myxozoans, trematodes, cestodes, acanthocephalans, nematodes and crustaceans [2].

The Food and Agricultural Organization of the United Nations [3] reported that, to satisfy an increasing demand in freshwater fish, extensive research must include studies of their parasites for optimal production levels. The knowledge of fish parasites is of particular interest in relation not only to fish health but also to understanding ecological problems in tropical Africa. Fish parasites have long been recognized as serious threats of fish both in aquaculture and fisheries [4].

Most parasites are easily transferred from the wild stocks to cultured stocks due to their direct nature of transmission and lifecycle. Identifying parasites and studying their abundance will lead to developing prevention and control mechanisms. Studies on fish parasites in Ethiopia are very few research articles of which a few deal with parasites include a report of fish in Lake Tana, Lake Hawwasa, Lake Ziway and Koka Dame [5-7]. This indicates a slow progress in research in fish diseases in Ethiopia of freshwater fish parasites. There are also some recent published articles on parasites of Ethiopian water bodies such as Lake Lugo, Small Abaya, Lake Ziway and Lake Hawassa [8-11]. Gilgel Gibe-I dam has commercially important fish species where three fishery cooperatives are fishing in the dam. In addition, Sebeta fishery research centre is collecting fingerlings and

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disseminating them for small scale fish farmers when there is demand. Most parasites are easily transferred from the wild stocks to cultured stocks due to their direct nature of transmission and lifecycle. But in spite of the high commercial value of fishes in Gibe, there is no documented work for fish parasites in the dam. Therefore, this study was done to gather baseline information and forward recommendations on parasites of the two economically important fish *O. niloticus* and *L. intermedius* in Gilgel Gibe-I Dam, Ethiopia. The study was therefore, conducted to identify, quantify and determine the associated risk factors of the major parasites of *O. niloticus* and *L. intermedius*.

MATERIALS AND METHOD

Study Area: This study was conducted in Gilgel Gibe-I dam which is located 260 km South West of Addis Ababa in Jimma Zone, Oromia Regional state **(*Figure 1)***. It was created by impounding Gibe River to provide water for hydroelectricity. The Dam is situated at 7°49'53″N 37°19'18″ E in a closed basin at an altitude of 1890m above sea level and covers approximately 164 km^2. The water from the dame is used extensively for hydropower generation (183 MW), domestic water supplies and commercial fishing.

Study Design: A cross sectional study was conducted from October, 2015 to August, 2016 to identify and determine the prevalence, intensities and abundance of randomly selected *O. nilotocus* and *L. intermedius* fish species parasites in Gilgel Gibe-I dam. The sample size was determined by using the formula described by Thrusfield [12] using 95% confidence interval and 5% absolute precision and at 50% expected prevalence of parasites. Accordingly, a total of 768 fish including 384 *O.niloticus* and 384 *L. intermedius* fish were included in the current study.

Collection of Fish: Fish were collected mostly by fishing with different net sizes (6cm, 8cm, 10cm, 12cm, 14cm and 16cm) and occasionally from the fishermen. The fish was put in a fish tank with the lake water and oxygen filled polyethane bag and transported alive to the National Fishery and Aquatic Life Research Center, Sebeta. They were killed by severing the spinal cord. All fish were

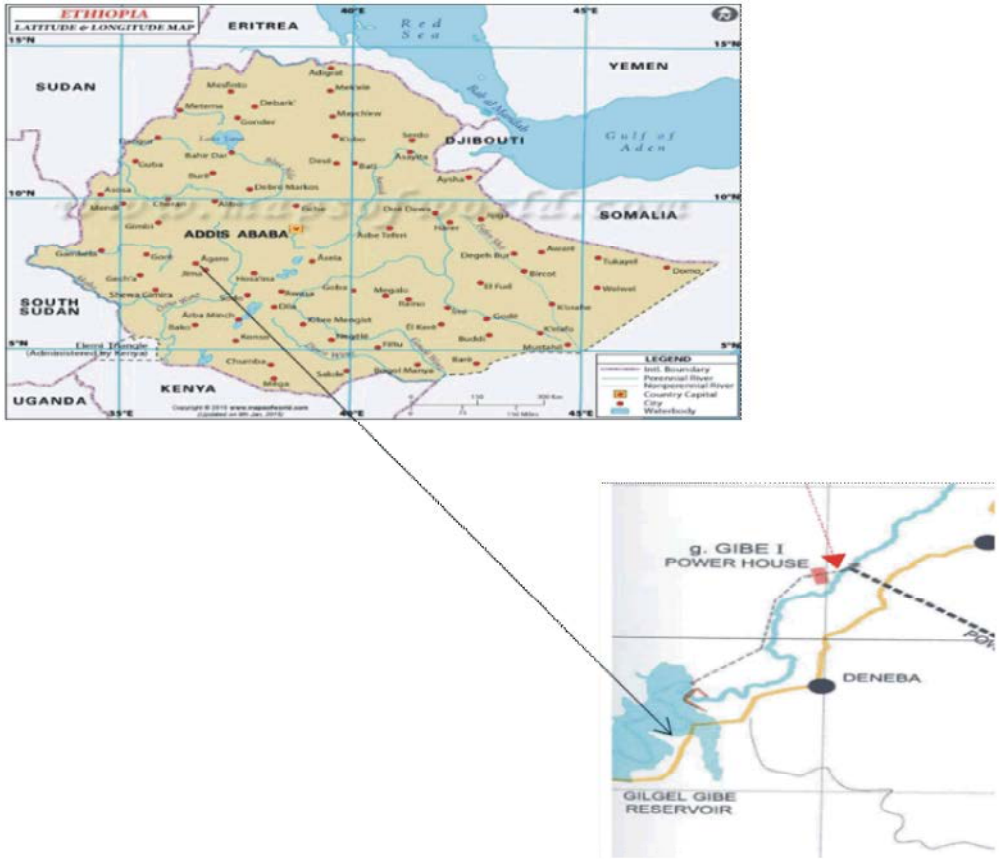

Fig. 2: The map and location of Gilgel Gibe-I dam

weighed and the total length of the fish were taken using digital weighing balance and meter rule respectively and recorded. Measurements of hosts were taken for comparison of parasite prevalence and host age.

Examination of Fish for Parasites: The external body surface including scales, gills, fins and operculum of freshly caught fish specimens were examined for external parasites with the aid of a hand lens, microscope and the unaided eye. After dissecting the fish, the gut was cut into oesophagus, stomach, small intestine, large intestine and rectum and examined for endo-parasites using clean implements to avoid transfer of parasites from one site to another. The liver and gonads were separated. The kidneys and the liver were also examined for the presence of parasites. The eyes and the orbits were examined extensively for trematode parasite presence microscopically.

Identification of Parasites: The identification of parasites collected were relied on (i) the comparison of distinctive body shapes and the morphological features of the collected specimen and those described in literature; (ii) a key to identification modified from Paperna [13] for identification of the major taxa of adult parasites of fish. Many specimens were identified to genera level.

Statistical Analysis: Data Was Put in Excel and Analysed: Descriptive statistics, percentages and 95% confidence intervals were used to summarize the proportion of the infested. Statistical significance was set at $p<0.05$. Parasites recovered were analyzed using the infection statistics of Bush *et al.* [14] such as prevalence, intensity and abundance.

$$\text{Mean Intensity} = \frac{\text{Total No. of fish infected with aparasites}}{\text{Total number of fish Examined}}$$

$$\text{Mean Intensity} = \frac{\text{Total No. of individual parasites of a spp}}{\text{Total number of hosts examined}}$$

$$\text{Mean Abundance} = \frac{\text{Total No. of individual parasites of a spp}}{\text{Total number of hosts examined}}$$

RESULTS

Identification of Common Parasites: In this study, eleven different family or genus of internal and external parasites was identified in the Gilgel Gibe-I dam. From the *O. niloticus* examined during the study period, three genera of Digenea, one genera of Monogeneans, one genera of Nematoda and two genera of Crustacea were found from the study sites. Table 2 shows a list of parasites from *O. niloticus*. In *L. intermedius* fish, one genus of Monogeneans, one genus of Digeneans, Two genera of Namatoda, one genus of Crustaceans and unidentified cestode parasites were observed (Table 3).

Three Digenean parasites were identified from *O. niloticus* in Gilegel gibe-I dam including *Clinostomum* spp. *Euclinostomum* spp. and *Tylodelphys* spp. *Clinostomum* spp. identified from *O. niloticus* were mostly encysted in the brachial cavity just behind the gills of the fish. They are also found as yellow cysts on the skin below the scales of the fish with intensities of 5.19. *Euclinostomum* spp. was found inhibiting as large round cysts in anterior and posterior regions of the kidney with an intensity of 4.1. *Tylodelphys* spp. was predominantly found unencysted swimming actively in the vitreous humour of the eyes of *O. niloticus* and *L. intermedius*.

Adult cestodes of unidentified species were found free in the gut lumen (Fig. 4a) and larval cestodes were found encysted in intestinal wall and liver of *L. intermedius* microscopically. The nematodes *Conracacum* spp. larval stage from Nile tilapia were found coiled in the pericardial cavity and also sometimes found dispersed in the abdominal cavity. This parasite was also found inserted and coiled in the mesentery, liver, gonads and gas bladder of *L. intermedius* fish species. The nematode *procamallanus* spp. was observed in the intestine of *L. intermedius*.

The genus Learnea was the most common external copepod parasite found attached in gills, operculum, fin and the skin on both *O. niloticus* and *L. intermedius*. The parasite penetrates the skin and causes to wound the fish which consequently exposes for secondary infections. *Argulus* spp. was also observed crawling under the fins of the *O. niloticus* fish only. Two species of monogeneans called *Dactylogyrus* spp. from the gill of *L. intermedius* (Fig. 8a & b) and *Cichlidogyrus spp*. from the skin scrapings of *O. niloticus* were observed under microscope in this study.

Prevalence Rates, Intensities and Abundances of Parasites

Overall Infection Rates: In this study, a total 768 fish including 384 *O. niloticus* and 384 *L. intermedius* were caught and examined for the presence of parasites from October, 2015 to August, 2016. From a total of fish examined 615 (80.0%) had parasitic infection harbouring at least one internal or external parasite and 208 (27.08%)

Table 1: Total and multiple infection prevalence of parasites in fish of Gilgel Gibe-I dam.

Total infection				Multiple infection	
Fish spp.	Sampled (N)	Infected (n)	P (%)	infected	P (%)
O. niloticus	384	378	98.43	151	39.32
L. intermedius	384	237	61.72	57	14.84
Total	768	615	80.00	208	33.77

P=prevalence

Table 2: Prevalence, mean intensity and mean abundance of infection by different parasites in *O. niloticus* at Gilgel Gibe-I dam (n = 384)

Parasite	Localization	Number infected	P (%)	MA	MI
Contracacum spp.	Pericardial cavity	378	98.4	13.7	13.9
Tylodelphyes spp.	Eye	77	20.0	1.2	6.33
Clinostomum spp.	Gill, Brachial cavity	16	7.0	0.37	5.18
Euclinostomum spp.	Kidney	51	13.2	0.54	4.1
Cichlidogyrus spp.	Gills	15	3.9	-	-
Leech	Operculum	5	1.3	0.03	2.66
Learnea spp.	Skin	18	4.6	0.12	2.54
Argulus spp.	Skin	7	1.8	0.03	1.7

P = prevalence, MI = Mean Intensity, MA= Mean Abundance

Table 3: Prevalence, mean intensity and mean abundance of infection by different parasites in *L. intermedius* at Gilgel Gibe-I dam (n = 384)

Parasite	Localization	Number infected	P (%)	MA	MI
Larval Cestode	Intestinal lumen	36	9.6	0.098	4.22
Learnea spp.	Skin	171	45.23	1.40	3.15
Tylodelphyes spp.	Eye	21	5.55	0.42	7.71
Dactylogyrus spp.	Gill	15	3.96	-	-
Myxobolus spp.	Gill, viscera	42	11.11	-	-
Contraceacum spp.	Mesentery	33	8.73	1.57	18.27
Procamallanus spp.	intestine	12	3.17	0.21	7

P = prevalence, MI = Mean Intensity, MA= Mean Abundance * Dashes denote unavailability of data.

had multiple infections (Table 2). Out of the 384 *O. niloticus* examined in the study area, 378 (98.430%) of them were found infested with single or multiple parasites belonging to different genera whereas 237 (61.71%) of the *L. intermedius* were found infected with one or more than one genera of parasites. There was statistical significant difference ($p<0.05$) between the two animal species in overall prevalence of the parasite infestations. Different types of parasites both from internal organs and external body surfaces of the both fishes were identified (Table 1).

Parasite infection rates in *O. niloticus*: Out of the 384 *O. niloticus* examined, 378 (98.430%) of them were found infested with single or multiple parasites belonging to different genera. Among them, 151(39.32%) were found harbouring more than one external or internal parasites. The most dominantly prevalent parasites in *O. niloticus* belongs to the Nematode *Contraceacum* spp (98.43%) followed by the trematode; *Tylodelphyes* spp. (20.0%).

The larval nematode *Contraceacum spp.* was the most prevalent parasites affecting *O. niloticus* fish species and it was recovered from the pericardial cavity of 378 (98.6%) *O. niloticus*. The mean intensity and mean abundance of the parasite was found to be 13.6 and 13.4 respectively per fish. *Tylodelphyes* spp. were the second most prevalent Digenean parasite of *O. niloticus* that were recovered from eye of 77 (20%) fish with intensity of 6.33 per fish. The other Digenean parasite *Euclinostomum* spp. were recovered from the kidney of 51 (13.33%) *O. niloticus* fish with mean intensity of 4.1. The *Clinostomim* spp. were recovered from brachial cavity, skin and gill of *O. niloticus* with prevalence of 35 (9.11%) and mean intensity of 5.18 per fish. The only monogenean parasite found in *O. niloticus* was *Cichlidogyrus* spp. from the gill with prevalence of 15 (4%). Among the crustacean parasites, *Learnea* spp. and *Argulus* spp. were recovered from 18 (4.9%) and 7 (1.8%) of *O. niloticus* respectively. Leech was also found from five of the *O. niloticus* fish with prevalence of 1.3% and mean intensity of 2.66 (Table 2).

Parasite Infection Rates in *L. intermedius:* Out of the 384 *L. intermedius* examined in this study, 237 (61.71%) were found infected with one or more than one genera of

Table 4: Prevalence of parasites in relation to species and sex of fish in Gilgel Gibe-I dam.

	No. Examined			No. Infected (%)		
Variables	Male	Female	Total	Male	Female	Total
O. niloticus	194	190	384	192 (98.96)	186 (97.8)	378 (98.4)
L. intermedius	175	209	384	111 (63.42)	126 (60.2)	237 (61.7)
Total	369	399	768	303 (82.11)	312 (78.1)	615 (80.0)

* P= 0.199, P>0.05

parasites. Fifty seven (14.84%) were infected by multiple parasite infections. The parasite fauna observed in this fish include the nematode *Contraceacum* spp. *and Procammalanus spp;* the trematode *Tylodelphyes spp;* unidentified Cestode; the Crustacean *learnea spp*. and *Myxobolus spp*. (Table 3).

The most dominant parasite in this fish was the Crustacean *Lernea spp.* with prevalence rate of 171 (45.23%). The mean intensity and mean abundance of the parasite was 3.14 and 1.40 respectively. The second prevalent parasite was the *Myxobolus* spp. found encysted as white patches in the gills and mesentery of the fish and 42 (11.11%) of them were found infested by this parasite.

Unidentified cestode larvae were recovered from 36(9.6%) of *L. intermedius* fish species with mean intensity of 4.22 per fish. *Tylodelphyes spp.* were the only Digenean parasite of fish that were recovered from 21 (5.55%) of *L. intermedius*. Among the nematode genera, *Contracaum* spp. and *Procammalanus* spp. were encountered from 33 (8.73%) and 12 (3.17%) of the fish examined respectively. *Dactylogyrus* spp. was the only monogenean parasites found from the gill of *L. intermedius* with prevalence rate of 3.96% (Table 3).

Prevalence of Parasites in Relation to Sex: Out of the examined 369 male fish, 303 (82.11%) were infected by one or more parasites as shown in Table 5. On the other hand, of the examined 399 female fish, 312 (78.19%) were affected by parasites of fish (Table 4). The prevalence of the parasites did not show any statistical significant difference between male and female fish (p>0.05).

DISCUSSION

The current finding indicated that the overall prevalence of fish parasites in *O. niloticus* and *L. intermedius* was 80%. The prevalence of parasites in *O. niloticus* was 98.43% and that of *L. intermedius* was 67.71% and the prevalence of the parasites in the two fish species was statically significant (P<0.05). This significant variation in prevalence of parasites in the two hosts might be attributed to the different habitat use and diet [16]. *O. niloticus* forms and defends territories along the shores. This territorial behaviour increases the proximity to and maintains continuous exposure to crustaceans, nematode and digenetic trematodes cercariae [15]. Nile tilapia feeds mainly on phytoplankton and macrophytes although zooplankton and benthic organisms also contribute to the diet [16]. Because zooplankton and benthic organisms act as intermediate hosts for several helminths, their intake exposes the fish to infections. In contrast, *L. intermedius* prefers marginal weedy and muddy waters [17] and feeds on a wide range of food items including detritus, zooplankton, insects and fish, all of which act as intermediate hosts for several helminths. However, the contribution of zooplankton to the diet of *O. niloticus* is low, might be thus limit the intake of the parasites [17].

The most prevalent larval nematode was *Contracecum* spp. that was recovered from the pericardial cavity of *O. niloticus* and from messentry of *L. intermedius* spp. Infection by larval nematodes of the genera *Contracecum*, *Amplicacum* and *Eustrongiloides spp*. is common in Africa [18] and recorded from fish of Ethiopian water bodies [7-9, 11]. In Ethiopia, *Contracecum* spp. are known to be present in fish from lakes Chamo, Awassa, Ziway and Tana, Hashengie, Yimlo ponds, Babogaya, Haike [9-12].

In this study, the prevalence of *Contracecum* spp. in *O. niloticus* was 98.43% with a mean intensity of 13.9 worms per fish. This was higher than the one reported by Yimer [7] of *contracecum spp.* in *O. niloticus* spp. in Lake Tana [7] of 48.12% and Amare [6] of 8% at Lake Hawassa. Shibiru *et. al*., [5] indicated the prevalence of this parasite decreased to 62.22% in the same species of fishes from the same lake (Lake Hawassa) with mean worm of 6.3.

In the present study, 20.8% of *L. intermedius* fish were infected by *Contraceaum* spp. in the mesentery. This was higher than the one reported by Shibru and Tadesse [5] at Lake Tana with prevalent rate of 10.72%. The variations could be due to the prevalence of crustaceans which are the first intermediate hosts prevailing in the areas during the sampling periods [10]. It could also associated with environmental and host body

condition. The highest prevalence and intensity in the dam might be due to the maturation of parasites in large number of piscivorous birds around the lake which allow parasites to reproduce more and infect large number of fish hosts. Almost all fish caught by fishermen are eviscerated along the shore and washed into the lake and eaten by birds causing recontamination of the lake that in turn increases parasite burden per fish. *Contracecum* spp. gives wormy appearance when opened the whole fish and it reduces the market value of the fish consequently affects its economic value. The higher prevalence of *Contracecum* spp. might also be due to the fact that the parasite infests wide range of aquatic birds that can serve as final and intermediate hosts (Cormorants and pelicans) and larval stages are known to occur in most African fresh water fish, including Carp and related species, channel catfish and tilapia [19]. These fish eating birds were also found many in the study area from our observational study.

Infection of fish by the metacercarial stages of the Digenean trematodes *Clinostomum* spp. and *Euclinostomum* spp. is common in Africa. Yimer [9] at lake Ziway, Florio *et al.* [8] at lake Hawassa and Amare *et al*. [10] at Lugo Lake recorded *Clinstomum* spp. with a prevalence rate of 62.22%, 32.3% 20.9% and 74.3% respectively. These findings are higher than the findings of the current study whereby a prevalence rate of 20.8% was recorded in *O. niloticus.* But it has a similar prevalence rate in Lugo Lake reported by Amare *et al.* [10] with prevalence of 20.9 %. *Clinostomum* spp. inside body cavities and produces yellowish discoloration while those affecting the skin produce dark discolorations that often result in consumer rejections by imparting unsightly appearance to the fish affected. It has also public health importance by causing human illness when ingested uncooked.

Tylodelphyes spp. was recovered from the vitreous humour of 77 (20 %) of *O. niloticus* and 21 (5.55%) of *L. intermedius* which is lower than that of Yimer [7] who reported prevalence of 41.97% and 59.38% of the fishes of *O. niloticus* in in lakes of Ziway and Haik respectively. The result of this study was higher than the one reported by Yewubdare *et al*. [20] in Koka Dam with prevalence of 4.1%. This variation may be attributed to the availability of piscivorous birds and snail intermediate host. However, the presence of large number of eye fluke in the eye can lead to blindness and susceptible to predation and reduced growth rate. The free metacercaria are known to cause severe damage to the lenses [18] and hence lens cataract and consequently blindness follows. Since blind fish cannot feed properly, useful fishes could easily be destroyed as a result of wasting of the body due to improper feeding and predation.

In the present study, males had higher prevalence than females. This can be attributed to the changes in the level of ostradiol hormone which could be considered as a factor for reducing the number of parasite in females. An increase in hormone ostradiol in frogs was responsible for reducing the number of helminth parasites. Similar findings have been observed by other workers [21].

In conclusion, the present study showed that different genera of parasites were identified in *O. niloticus* and *L. intermedius* fish in Gilgel Gibe-I dam. Two genera of the Nematoda, three genera of the Digenean, two genera of Monogenea, two genera of Crustacean, unidentified cestode and Leech were identified. The nematode *Contracaecum* spp. was found to be the most dominant internal parasite of *O. niloticus* in the study area. *Tylodelphyse spp*. and *Euclinostomum spp*. were also the common Digenean parasites recovered from *O. niloticus.* The genera Learnea was the most dominant parasite in *L. intermedius* followed by *Myxobolus spp*. Parasites were relatively more prevalent in *O. niloticus* than *L. intermedius*. Fish sex and seasons do not show difference in the prevalence of parasites but bigger *L. intermedius* had higher prevalence than smaller fish. The condition factor of the fish infested by different fish parasites was not affected significantly. The Digenean *Clinostomum* spp., the Cestodes and the nematode *Contracaecum* spp. could represent potential human health risks of eating uncooked or slightly cooked fish. From this study, the following points can be recommended;

- Fishermen should not dispose waste and offal at the shore of the Dam to avoid the existing re-contamination of the lake and to break the life cycle of parasites of fish.
- Consumers should not eat uncooked or slightly cooked fish and health education should be given for them on the risk of eating raw and partly cooked fish.
- Further research should be conducted for correct identification of the parasite species by morphological and molecular techniques and their intermediate hosts may allow in future in defining preventive measures.

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