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THE EFFECTS OF GASTROINTESTINAL HELMINTH PARASITES INFECTION ON THE CONDITION FACTORS OF FISHES FROM WARRI RIVER, SOUTHERN NIGERIA

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ABSTRACT

This study presents the effects of gastrointestinal helminth parasites infection on the condition factor (K) of fishes caught from Warri river, over a period 12 months (June, 2010 to May, 2011). Of 800 fishes (belonging to 56 fresh and brackishwater species) examined during the study, 222 (27.5%) were infected with gastrointestinal helminth parasites belonging to three phyla, Platyhelminthes, Nematoda and Acantocephala. The K values of fishes infected with gastrointestinal helminth parasites ranged from 0.03 to 5.05 while that of non-infected fishes ranged between 0.22 and 8.75. The mean K values were not significantly different (P> 0.05). Nevertheless, there was a significant difference in the K value between the sexes for the helminth infected fishes. The males had significantly higher mean condition factor (2.11 $\pm$ 1.27) than the females (1.78 $\pm$ 1.16) (P < 0.05). However, for the non-infected fishes, the females recorded a marginal higher mean K value of 1.85 $\pm$ 1.50, than the males with a mean K value of 1.83 $\pm$ 1.32 (P>0.05). The mean standard length (SL) of fishes infected with gastrointestinal helminth parasites in the K value range of 1.1–2.0 was significantly higher than that of non-infected fishes (P < 0.05). The results also showed that as the condition factor increased, there was a significant decrease in the standard length of fish.

KEYWORDS: *Condition factor, gastrointestinal, helminth parasites, fishes, Warri river.*

INTRODUCTION

Fishes are important sources of protein for humans and contribute a great deal to available food resources worldwide. However, fishes are not only the hosts of many adult helminth parasites but also the hosts of larval forms, the adults of which occur in birds, mammals and predatory fishes. Helminth parasites belong to the phyla Platyhelminthes (flatworms), Nematoda (roundworms) and Acanthocephala (thorny-headed worms).

Adult helminths commonly occur in the digestive tract of fishes. The invasion of the alimentary canal of fish by most adult helminths can elicit disruption of gut tissues and gut function (Paperna,

1996). Condition factor is an index of the degree of fatness or well being of a species. Among fishes, species which are well fed are better conditioned than the same species which are poorly fed (Egborge, 1994). The condition factor (K) is calculated by dividing fish weight by length cubed (W/L^3) Gayanilo *et al*., 2005).

The condition factor expresses the degree of fitness or physiological state of a fish and is based on the assumption that heavier fish of a given length is in a better condition (Bagenal and Tesch, 1978). This implies that the heavier a fish for a given length, the higher its condition factor. Indeed, condition factor is an index often applied when checking growth rate of fish and it is one of the basic tools in fish culture management.

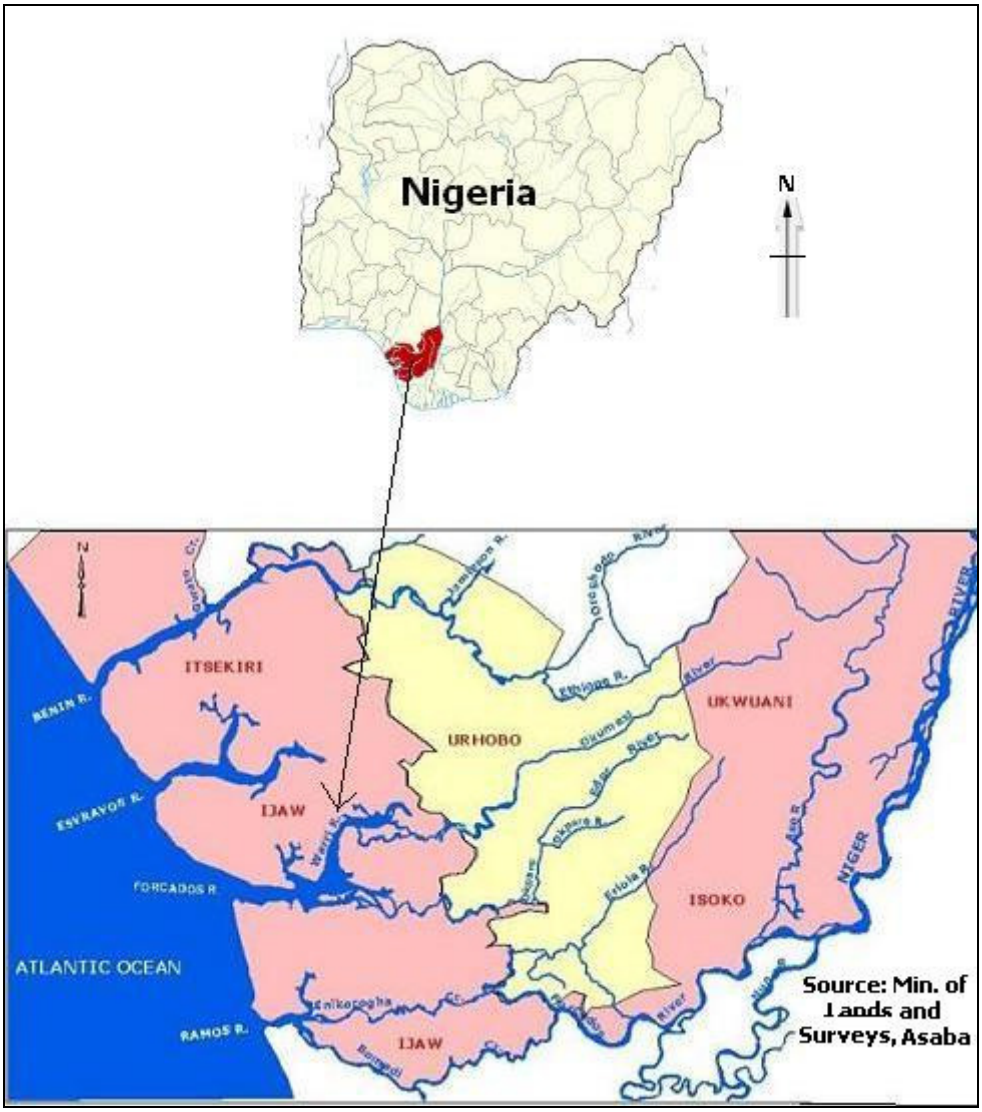
Condition factors of different fish species have been reported. Several of these reports have focused on the determination of changes in condition factor with season (Ekelemu and Zelibe, 2006; Abowei, 2009; Sanyang *et al.,* 2011; Dirican and Cileic, 2012), age (Mims and Knaub, 1993; Lizama and Ambrosio, 2002; Hart and Abowei, 2007), sex (Barnham and Baxter, 1998; Simon, *et al.,* 2013), fish length (Anene, 2005), fish growth (Bagenal and Tesch, 1978), feeding activity (Ighwela *et al*., 2011) and the productivity of a water (Sachidanandamurthy and Yajurvedi, 2008; Wogu, 2010).

Since gastrointestinal helminth parasites could alter the general physiology of hosts, including growth rate and reproductive capacity, the condition factor is therefore one parameter that has to be considered when making assessments of fish health. However, the literature on the relationship of helminth parasites infection and the condition factor of fish is scanty. The present study aims at providing information regarding the effects of gastrointestinal helminth parasites infection on the condition factors of fishes from Warri river, southern Nigeria.

MATERIALS AND METHODS

Warri River is located in the oil-rich belt of Nigeria's Niger Delta. It has a length of about 150 km and the main channel of the river joins the Forcados estuary, which empties into the Atlantic Ocean (Figure 1). Warri River lies within latitudes 5°21′–6°N and longtitudes 5°24′– 6°21′E. The climate of the study area is tropical with two recognizable seasons of variable durations, the dry and the rainy seasons. The fringing vegetation of Warri River changes from a freshwater evergreen forest at it's source to mangrove swamps at the lower reaches. In the latter region and as far as to Warri town, the outer marginal vegetation is characterized by mangrove plants with complex system of stilt roots.

Figure 1: Map of Warri River (Map of Nigeria Showing Delta State Inset)



Samples Collection

Fish samples were caught by hired fishers at different locations along the lower reaches of the Warri River. The fishers used a wide range of fishing gears such as gill nets (mesh sizes: 10, 20, 30 and 40 mm), cast nets of different mesh sizes and traps. Fish specimens were collected monthly from June 2010 through May 2011. The fish samples were stored in coolers containing ice and transported to the laboratory where they were counted and differentiated into separate sexes.

Fish samples were identified to species level using keys given by Leveque e*t al.* (1990) and Idodo-Umeh (2003). Fish measurements were taken

according to Barnham and Baxter (1998); Abowei *et al*. (2009). Total length (TL), standard length (SL) and body weight (W) were recorded to the nearest 0.1cm and 0.1g, respectively.

The condition factor for each fish was calculated from the equation

$$K = \frac{100 \times W}{L^3},$$

where K is the condition factor, W is whole body weight (g) and L is the standard length (cm) (Gayanilo *et al*., 2005).

Examination of fish for the presence of gastrointestinal helminth parasites

The ventral surface of each fish was slit open and the alimentary canal was carefully removed and cut into sections corresponding to the oesophagus, stomach and intestine. Each section was placed in different Petri-dishes containing normal saline. An incision was made along the length of each section and the exposed surface and content were examined for helminth parasites under a dissecting microscope. All helminth parasites observed were counted, and fixed in 4% formalin. Digeneans, cestodes and acanthocephalans were stained with Ehrlich hematoxylin, dehydrated using a graded alcohol series, cleared in methyl salicylate and mounted whole. Nematodes were cleared with glycerine for light microscopy and stored in 70% ethanol.

Using appropriate keys as provided by Khalil *et al*., (1994), Jones *et al*., (2005), Anderson *et al*., (2009) and Amin (2013), the helminth parasites were identified and classified into various taxa. Samples of the helminths were transferred into vials, properly sealed and labeled and sent to the Natural History Museum, London, for the confirmation of identification to species level.

Condition factors were computed for the 800 individual fishes caught from June 2010 through May 2011. Since samples were wild caught fishes of unknown ages, all fishes were placed in six groups based on their condition factor value ranges of 0.1-1.0, 1.1-2.0, 2.1-3.0, 3.1-4.0, 4.1-5.0 and >5.1 for the two categories of (a) gastrointestinal helminth parasites infected fishes and (b) non-infected fishes.

Data Analysis

Student's unpaired t-test and analysis of variance (ANOVA) were used to compare differences and to test for the significance of differences.

RESULTS

A total of 800 (fresh and brackishwater) fishes belonging to 56 species (Table 1) were examined during this study, and 222 (27.75%) were infected with gastrointestinal helminth parasites.

Table 1: List of the 56 fish species from Warri River examined during the study period

Family	Species
Anabantidae	*Ctenopoma kingsleyae*
Ariidae	*Arius gigas*
Bagridae	*Chrysichthys furcatus*, *C. nigrodigitatus* and *C. walkeri*
Bothidae	*Citharichthys stampfli*
Carangidae	*Caranx hippos*, *C. senegalus* and *Trachinotus falcatus*
Channidae	*Channa obscura*
Characidae	*Brycinus macrolepidotus* and *B. nurse*
Cichlidae	*Chromidotilapia guentheri, Hemichromis fasciatus, Oreochromis niloticus, Sarotherodon melanotheron, S. niloticus, Tilapia mariae*, *T. zillii*
Clariidae	*Clarias gariepinus* and *Heterobranchus senegalensis*,
Clupeidae	*Ethmalosa fimbriata, llisha africana*, *Pellonula afzeliusi*, *Sardinella maderensis*
Cynoglossidae	*Cynoglossus senegalensis*
Cyprinidae	*Labeo senegalensis*
Distichodontidae	*Distichodus brevipinnis* and *D. rostratus*
Elopidae	*Elops lacerta*
Gymnarchidae	*Gymnarchus niloticus*
Hepsetidae	*Hepsetus odoe*
Lutjanidae	*Lutjanus goreensis*
Malapteruridae	*Malapterurus electricus*
Mochokidae	*Synodontis punctifer*
Monodactylidae	*Monodactylus sebae* and *Psettias sebae*
Mormyridae	*Mormyrops anguilloides*
Mugilidae	*Liza falcipinnis*, *L. grandisquamis* and *Mugil cephalus*
Notopteridae	*Papyrocranus afer* and *Xenomystus nigri*
Osteoglossidae	*Heterotis niloticus*
Polynemidae	*Galeoides decadactylus* and *Polydactylus quadrifilis*
Pomadasyidae	*Plectorhynchus macrolepsis, Pomadasys jubelini*, *P. peroteti*
chilbeidae	*Phyrailia pellucid, Schilbe mystus*
Scianidae	*Pseudotolithus elongatus, P. senegalensis*
Scombridae/Cybiidae	*Scomberomorus tritor*
Sphyraenidae	*Sphyraena afra, S. sphyraena*

The helminths recovered belong to three phyla (Platyhelminthes, six species, Nematoda, (thirteen species) and Acanthocephala, (three species) (Table 2).

All the 56 species of fish used in this study had individual fishes that were either infected with helminths or not infected. For example: *Clarias gariepinus* (Clariidae), some individual fishes of this species were infected with gastrointestinal helminth parasites, while others of the same species were not infected by helminth parasites. This natural occurrence provided a good opportunity of ensuring a fair comparison of the same species of fish from the same ecosystem in which they live, with

regards to the effects of gastrointestinal helminth parasites infection on the condition factor of host fishes.

Table 2: List of the gastrointestinal helminth parasites isolated from fish hosts in Warri River during the study period.

Phylum	Species
Platyhelminthes	*Allocreadium* sp., *Aspidogaster africanus*, *Orientocreadium* sp., *Plagic* *Lytocestoides* sp., and *Wenyonia acuminata.*
Nematoda	*Capillaria* sp., *Cylicostrongylus* sp., *Rondonia* sp., *Cithariniella* sp., *Spironoura* sp., *Quimperia* sp., *Goezia* sp., *Paracamallanus cyathopharynx*, *Procamallanus laeviconchus*, *Spirocamallanus spiralis*, *Cucullanus* sp., *Rhabdochona* sp. and *Spinitectus* sp.
Acanthocephala	*Acanthogyrus tilapiae*; *Paragorgorhynchus* sp. and *Tenuisentis* sp.

From Table 3, the mean K values of the helminth parasites infected fishes was lower than those of non-infected fishes of the same groups, but the difference was not significant, P>0.05. Besides, no fish sample infected with gastrointestinal helminth parasites recorded a condition factor value of 5.1, whereas 29 non-infected fishes had K values of 5.1 and above.

Table 3: Test of significance between the condition factor of gastrointestinal helminth parasites infected and non-infected fishes using unpaired t-test.

Condition Factor (K)					
Groups (Range of K values)	Infected fishes		Non-infected fishes		P-value[b]
	N[a]	Mean±SD	N	Mean±SD	
0.1-1.0	60	0.65±0.27	179	0.66±0.24	P>0.05
1.1-2.0	97	1.54±0.28	211	1.58±0.28	P>0.05
2.1-3.0	41	2.45±0.25	87	2.52±0.30	P>0.05
3.1-4.0	16	3.56±0.36	36	3.61±0.29	P>0.05
4.1-5.0	08	4.52±0.27	36	4.58±0.29	P>0.05
>5.1	0	-[c]	29	6.47±1.12	-
Total	222		578		

[a]N is number of fishes, [b] P > 0.05 and P < 0.05 mean, not significant and significant respectively, [c] means no data.

For the helminth infected fishes, the mean K value for males (2.11±1.16) was significantly higher than the mean K value of females (1.78±1.16).

Table 4: Test of significance in the mean condition factor and standard length (SL) of gastrointestinal helminth parasites-infected fishes, with reference to sex using unpaired t-test.

	Mean ± SD		
Infected Fishes	Male	Female	P-Value[a]
Condition Factor	2.11± 1.27	1.78 ± 1.16	P<0.05
Standard length (cm)	21.28 ± 8.34	23.01± 9.49	P>0.05

[a] P > 0.05 and P < 0.05 mean not significant and significant respectively.

For non-infected fishes, the mean K value of female fishes (1.85±1.50) was relatively greater that of males (1.83± 1.76), but the difference was not significant (P>0.05) (Table 5).

Table 5: Test of significance in mean condition factor and standard length of non-infected male and female fishes, using unpaired t-test.

	Mean ± SD		
Non-Infected Fishes	Male	Female	P-Value
Condition factor	1.83 ± 1.76	1.85 ± 1.50	P>0.05
Standard length (cm)	21.22 ± 8.28	22.18 ± 1.85	P>0.05

[a] P > 0.05 and P < 0.05 mean not significant and significant respectively

From Table 6, in the group with the condition factor range of 1.1–2.0, the mean standard length of helminth parasites infected fishes was significantly higher than that of non-infected fishes of the same group (P < 0.05). Also, as the condition factor value increased, there was a significant decrease in the standard length of fishes.

Table 6: Test of significance between the standard length (SL) of gastrointestinal helminth parasites infected and non- infected fishes using unpaired t-test.

Standard Length (cm)					
Range of K values Groups	Infected fishes		Non-infected fishes		P-value[b]
	N[a]	Mean±SD	N	Mean±SD	
0.1 - 1.0	60	29.35±11.47	179	28.20±9.96	P>0.05
- 2.0	97	22.15±5.70	211	20.68 ±5.86	P<0.05
2.1 - 3.0	41	18.30±5.69	87	17.52±5.04	P>0.05
3.1 - 4.0	16	17.19±3.56	36	17.04±4.89	P>0.05
4.1 - 5.0	08	14.20±2.39	36	13.45±3.40	P>0.05
>5.1	0	-[c]	29	11.36±2.99	-
Total	222		578		

[a]N is number of fishes, [b] P > 0.05 and P < 0.05 are not significant and significant respectively,
[c] means no data.

In the other four groups, with K value ranges 0.1–1.0, 2.1–3.0, 3.1–4.0 and 4.1–5.0, the mean standard length of helminth parasites-infected fishes were higher than those of non-infected fishes of the same group, though the difference was not statistically significant.

DISCUSSION

An inevitable consequence of gastrointestinal helminth parasites infection is the induction of associated pathologies in fish hosts and condition factor, is one parameter that should be considered when making assessment of fish health.

From Table 3, the mean condition factors of fishes infected with gastrointestinal helminth parasites were lower than that of non-infected fishes in all the groups. The finding in this study of a lower condition factor of helminth-infected fishes compared with that of non-infected fishes is consistent with earlier reports given by Thomas (2002) and Wogu (2010). Thomas (2002) also observed that helminth parasites abundance in the salmonid fish in Teifi was positively correlated with the condition factor and the adipose index.

Also, whereas adult cestodes live in the gastrointestinal canal, some larval cestodes called pleurocercoids commonly occur encysted in the body cavities, muscles or internal organs of fish. These larvae are known to decrease carcass value if present in muscles, and impair reproduction when they infect the gonads (Klinger and Floyd, 2002). In some fish species, the gonads may weigh up to 15% or more of the total body weight. The value of the condition factor of fish also is greatly influenced by the gonads, the amount of fat reserve and degree of muscular development (Barnham and Baxter, 1998). Thus, heavily helminth-infected fish may have a poorer or lower condition factor than little or non-infected fish.

K value range recommended as suitable for mature fishes in water is 2.9–4.8 (Bagenal and Tesch, 1978). Over 50% of fish samples examined had K values outside the range of 2.9–4.8 recommended as suitable for mature fresh and brackish water fishes. This observation could be traceable to the fact that the fish samples caught in the wild were mixed, comprising of juveniles and mature fishes of unknown ages, belonging to 56 different species. Besides, the variation in K values outside the recommended range may be due also to adverse environmental conditions. Warri River is reported to be polluted by effluents from domestic and industrial sources (Egborge, 1994; Wogu, 2010).

It was found that for gastrointestinal helminth-infected fishes, the males recorded a significantly greater mean K value of 2.11±1.27 than that of females (1.78±1.16) ($P < 0.05$) (Table 4). For non-infected fishes, there was no significant difference in the mean condition factor with respect to sex. The females, however, recorded a marginal higher mean K value (1.85±1.50) than that of males (1.83±1.32) ($P > 0.05$) (Table 5).

The gender difference recorded in this study for the helminth-infected fishes could be due to alterations in the physiological status of fishes particularly in females. These could also have

resulted from differential feeding either in quantity or quality of food eaten. According to Barnham and Baxter (1998), the K value of fish is greatly influenced by the stage of development of the reproductive organs. These authors reported that the K value of female fishes will decrease rapidly when the eggs are shed. It is therefore suggested that the degree of development of the gonads or stage in the reproductive cycle, may also be an important factor in determining whether differences in condition factor values would exist between the sexes.

It was observed that the condition factor decreased significantly with increase in standard length of fish (Table 6). Similar observations have been reported for different fish species by some authors (Mims and Knaub, 1993; Lizama and Ambrosio, 2002; Anene, 2005). For the helminth infected fishes, the mean standard length ranged from 14.20cm to 29.35cm while that of non-infected fishes was between 11.36cm and 28.20cm. Besides, the mean standard length for each group of K value ranges of 0.1-1.0, 1.1–2.0, 2.1–3.0, 3.1–4.0, 4.1–5.0 and >5.1 was greater in helminth-infected fishes than that for their non-infected counterparts in the same group. Indeed, for the group with K value range, 1.1–2.0 the mean standard length of helminth-infected fishes was significantly higher than the mean standard length of their non-infected counterparts ($P<0.05$).
An explanation of this observation could be that the helminth parasites may have released factors that stimulate the hosts' immune and endocrinological systems to produce substances that enhance somatic growth and relatively inhibit reproduction of the host fishes (Thomas, 2002). It may also be that most gastrointestinal helminth parasites had preference for the better fed and larger sized fishes over the relatively poorly fed and smaller sized fishes of the same species.

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