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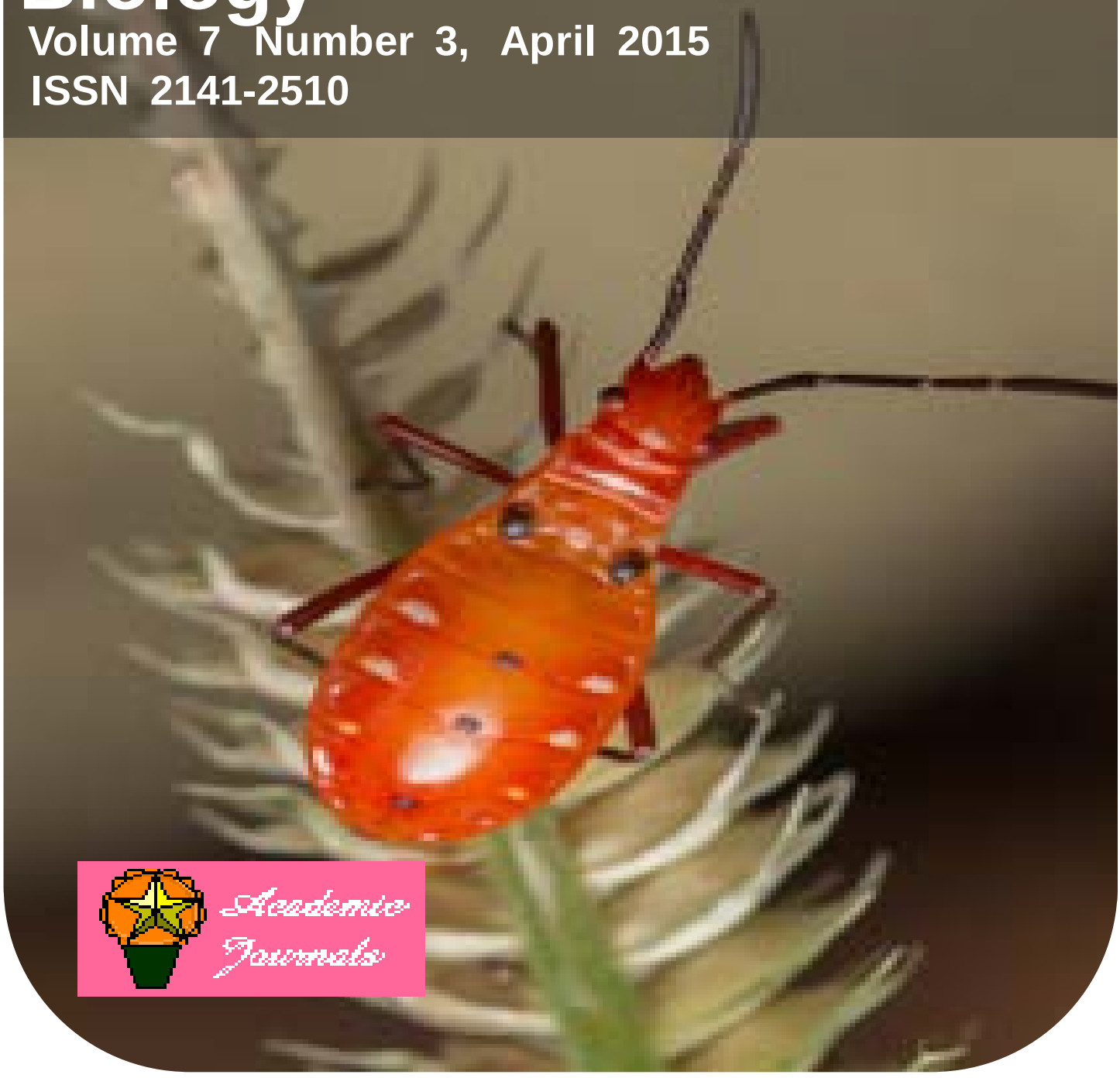

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Full Length Research Paper

New host record of *Abbreviata baltazardi* (Nematoda: Physalopteridae) from the lizard, *Laudakia (Agama) nupta* in Rawandoz mountains, Kurdistan Region

Zohair, I.F. Rahemo[2*], Sarbaz, I. Mohammad[1], Ferhank, A. Aola[1], Sherwan, T. Ahmed[1], Fekry, A. Kader[1] and Firas Kasim[1]

[1]Department of Biology, College of Science, University of Salahaddin, Erbil, Kurdistan, Iraq.
[2]College of Education, Hamdania University, Mosul, Iraq.

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This study investigation represents the first on parasites of the lizard, *Laudakia nupta nupta* not in Iraq but all over the world. An intestinal nematode, *Abbreviata baltazardi* has been recovered from the lizard, *L. nupta nupta* caught from Rawandos mountains in Kurdistan region, Iraq. The main characteristics of this nematode are: mouth with large simple triangular lateral lips armed with one tooth or more, two amphids were also observed in addition to external circle of papillae. Cuticle with clear transverse striations and may be reflected forwards over the lips to form cephalic collarette; oesophagus divided into two portions, glandular and muscular; excretory pore open at the anterior part of the body. Male 25 to 28 mm in length with well developed caudal alae meeting ventrally in front of cloaca, and usually supported by at least four pairs of long protruded papillae and a number of sessile papillae of which there are generally pre anal and five post-anal; spicules dissimilar. Female: 29 to 34 mm in length, vulva in the anterior half of the body; two uteri are present, uterus with 2 branches, oviparous, eggs elongated, smooth, thick-shelled, not capsulated, embryonated. *A. baltazardi* was collected from sunwatcher toad head agama, *Phryocephalus heliosopus*, *Skrijabinodon pigmentatus* and *Spauligodon lacerate* as such, *L. nupta nupta* is now considered a new host for this nematode. Moreover, Kurdistan represents a new locality of this species of nematode as no one reports this species from Kurdistan region.

Key words: Lizard, *Laudakia nupta nupta, Agama nupta.*

INTRODUCTION

In Iraq, there are several species of reptiles so, Khalaf (1959) wrote a book about them, in his book among the

*Corresponding author. E-mail: zohair_rahemo@yahoo.com.
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reptiles reported is *Agama nupta* De Filippi while its subspecies is *Agama nupta fusca*, while Mahdi and George (1969), gave the subspecies as *A. nupta nupta.* Anderson (1999), while describing Iranian reptiles gave some scattered information about Iraqi reptiles especially those found in close territory, he reported that *A. nupta* are found in the foothills of the Zagros mountains in eastern Iraq, but he changed the genus name to be *Laudakia nupta nupta*, with the *L. nupta nupta* called large-scaled rock *Agama*, while *A. nupta fusca* is yellow - headed *Agama.* Therefore, our species is *Laudakia (Agama) nupta nupta* as it is not yellow-headed.

Reptiles all over the world were investigated for their parasitic fauna. In India, Johnson (1966) described a new oxyurid nematode of genus *Thelandros* from *Calotes versicolor* (Daud, 1889) with a key to the Indian species of the genus *Calotes*. In the following year, Johnson (1967) reported the occurrence of *Thelandros alatus* (Wedl, 1862) in India. In Africa, Goldberg and Bursey (2001) studied the intestinal parasites of four species of skinks (*Mabuya*) from Southern Africa, were they reported five species of nematodes including *Abbreviata paradoxa,* and gave a comprehensive review of previous reports of helminthes from *Mabuya* spp.

In Nigeria, Omonon et al. (2011) carried out a parasitological study on *Agama* lizards (*Agama agama*) were they revealed two species of nematodes: *Strongyluris brevicaudata* and *Thelandros annulatus* estimating their percentage of infection. Recently, Halajian et al. (2013) studied the helminth parasites of the European glass lizard, *Pseudopus apodus*, European grass snake and *Natrix natrix* from Iran. One species of Nematode, *Entomelas entomelas* was revealed in *P. apodus.* Several research were performed in Iraq concerning nematodes of Iraqi vertebrates such as fishes (Rahemo, 1978; Ali et al., 1987; Moravec and Rahemo,1993; Moravec et al., 2009; Al-Jadoaa, 2002), amphibians (Al-Barwari and Nassir, 1983), birds (Al-Khateeb et al., 1982; Al-Alousi and Daoud, 1993; Al-Darajii et al.,1998) and mammals (Mahmoud, 1974; Shamsuddin and Mohammad, 1978) but very little on reptiles.

Al-Barwari and Nassir (1983) had recovered *Thelandros* sp. from two lizards, *Hemidactylus flaviviridis* and *H. persicus*. Later on, Hassan and Abdulla (1989) described *Thelandros* sp. and *Thelandros micilosae* from the rough-scaled gecko, *Cyrtodactylus scaber.* Al-Zako (1999), made a comprehensive survey on nematodes of amphibians, reptilians and birds, she described four species of nematodes from reptiles namely, *Neopharyngodon* sp. from *Gymnodactylus scaber*, *Thelandros vittatae* sp. from *Mabuya vittata, Trispulscaris* sp. from *Mabuya vittatae* and *Camllanus* sp. from *Testudo gracea*. Recently, Al-Barwari and Saeed (2007) investigated 7 species of Iraqi reptiles for helminthes perarasites, and they found 7 species of nematodes namely: *Thelandros* sp., *Microtetrameres* sp., *Angusticaecum holopterum*, *Tractis dactyluris, Tachygonetria nicolleri, Camallanus microcephalus* and *Falcaustra japonensis.* More recently, Al-Moussawi (2010) reported for the first time adult nematode *Tanqua anamala* from wall of gastro-intestinal tract of the dice snake, *Natrix tessellate tessellata*. As reported earlier, there is no report anywhere about the parasites of *Laudakia* (Agama) *nupta* neither from Iraq nor from any region of the world, so this study will provide the first investigation about parasites of the lizard, *L. nupta nupta*, and first host record of the nematode, *Abbreviata baltazardi*. Furthermore, Iraq is considered as a new locality of *Abbreviata baltazardi*.

MATERIALS AND METHODS

A collection trip was organized by Kurdistan natural history museum to Rawandos region by museum staff, and members of Biology Department on the 13 of October, 2013. By using a gun, two lizards were shot dead then dissected to obtain their viscera, both of them were fixed in 4% formalin, then brought to the laboratory of the museum to dissect the gastrointestinal tract. Only nematodes specimens were obtained, fixed in 4% formalin, examined under microscope after mounting in glycerin or water. The specimens then transferred to water adding 70% ethyl alcohol which was examined by the first author. Some specimens were sent to Dr Goldberg for examination. Photographs were taken using MDCE-5A digital camera.

RESULTS AND DISCUSSION

After thorough examination of more than 16 specimens of nematodes, it appears clearly that these nematodes belong to:

Order: Spiruridea
Family: Physalopteridae
Genus: *Abbreviata*
Species: *Abbreviata baltazardi*

Remarks: Mouth with large simple triangular lateral lips armed with one tooth or more, two amphids were also observed in addition to external circle of papillae. Cuticle with clear transverse striations and may be reflected forwards over the lips to form cephalic collarette (Figures 1 to 4). Oesophagus divided into two portions, glandular and muscular (Figure 2). Excretory pore open at the anterior part of the body (Figure 5) posterior to the nerve ring (Figure 5 and 6). Male: 25 to 28 mm in length with well developed caudal alae (Figure 6) meeting ventrally in front of cloaca, and usually supported by at least four pairs of long, protruded papillae (Figure 8), and a number

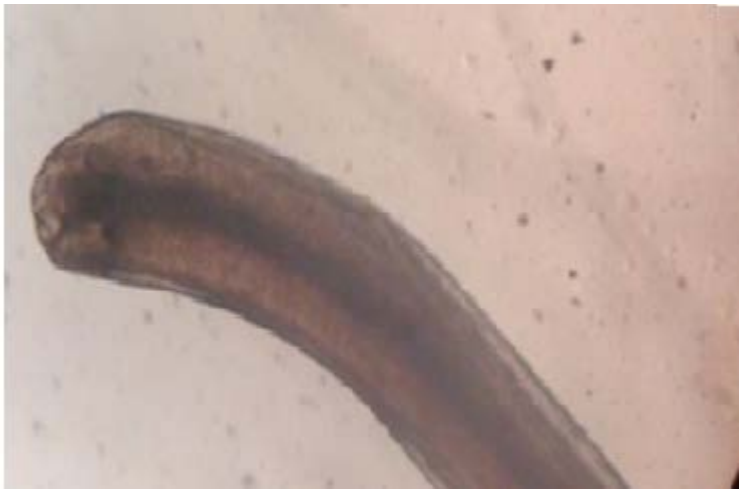

Figure 1. Photomicrograph of *Abbreviata baltazardi*: lips of the anterior region and papillae. ×100.

Figure 2. Photomicrograph of *A. baltazardi*, Nerve ring anterior to excretory pore and cephalic collaret. ×40.

of sessile papillae of which there are generally pre anal and five post-anal spicules dissimilar (Figure 9 and 10). Female: 29 to 34 mm in length, vulva in the anterior half of the body; two uteri are present, uterus with 2 branches (Figure 11); Oviparous; eggs elongated, smooth, thick-shelled, not capsulated (Figure 12), embryonated, measures in utero 0.065 to 0.077 in length and 0.043 to 0.051 mm in width.

Depending on the characters observed in these specimens, it can easily be placed under the family physalopteridae, with basic similarities to the species, *Physaloptera clausa* (Gorgani et al., 2013), different from *P. phryosoma* collected from the horned lizards from South-Western United States as the male spicules are not similar and eggs are capsulated, and the species measurement is quite smaller than the present specimens (Olsen, 1974). It is important to note that two species of *Abbreviata* have been reported from mammals, namely *Abbreviata caucasica* recovered from numerous mammals including *Gorilla gorilla* from

Figure 3. Photomicrograph of A. *baltazardi*: Clear cephalic collaret. ×40.

Figure 4. Photomicrograph of *A. baltazardi,* transverse striations and external circle of papillae in addition to central amphids. ×40.

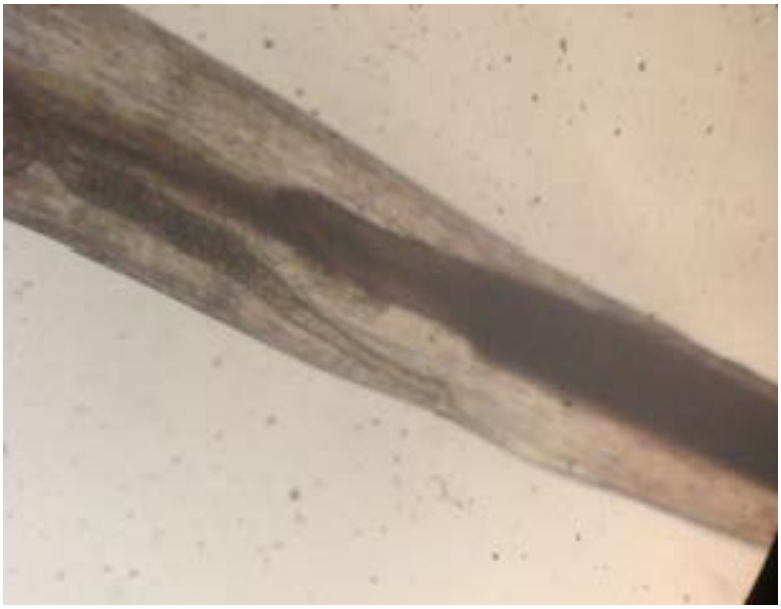

Figure 5. Photomicrograph of *A. Baltazardi*, excretory canal and excretory opening. ×100.

Figure 6. Photomicrograph of *A. baltazardi,* Nerve ring surrounding the esophagus. ×100.

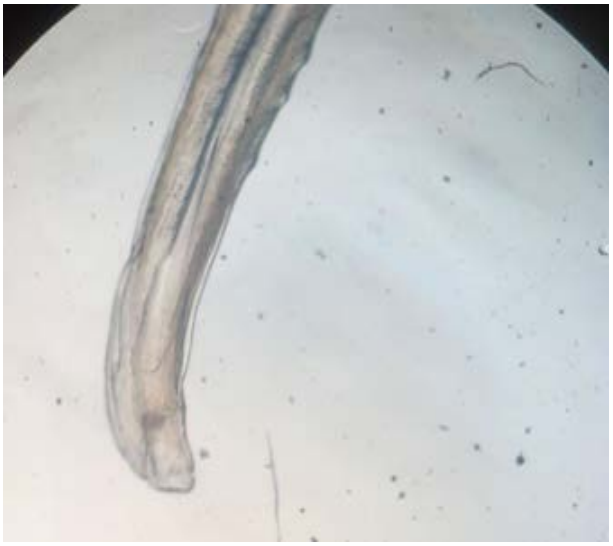

Figure 7. Photomicrograph of *A. Baltazardi* posterior end of the male with 4 pairs of papillae ×40.

Figure 8. Photomicrograph of *A. baltazardi*, male spicules ×100.

oesophagus, *Pongo pygmaeus* from stomach, *Cercopithecus mitis* from small intestines, *Macaca mulatta*, *Papio* sp and man. Other species, *Abbreviata poicilometra* has been recovered from *C. mitis* from stomach, and from *Cercocebus torquata* (Gorgani et al., 2013). Our specimens are clearly different from these two mammalian species in many characters. Halajian et al. (2013), reported that *Abbreviata baltazardi, Spauligodon lacerate, Skrjabinodon pigmentatus* and *Phryocephalus heliosopus* were recovered from the sunwatcher toad head agama.

Conclusion

Therefore, this study represents the first in Iraq. In addition, the lizard *L. nupta nupta* is considered a new host for the specie *A. baltazardi*.

Figure 9. Photomicrograph of *A. baltazardi*, two equal small male spicules ×100.

Figure 10. Photomicrograph of *A. baltazardi,* caudal alae of male ×100.

Figure 11. Photomicrograph of *A. baltazardi*, uterine branches ×100.

Figure 12. Photomicrograph of *A. baltazardi*, eggs ×400.

Conflicts of interest

The authors declare that they have no conflicts of interest.

ACKNOWLEDGMENT

The authors are very grateful to Prof. Dr Goldberg, Whittier College, California, USA for classifying our specimens after sending him both male and female adult lizards.

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Full Length Research Paper

Prevalence of helminthic fauna in wild pigs in comparison with domestic pigs: A study in the adjoining areas of Mudumalai, Anamalai and Sathyamangalam tiger reserves, Tamil Nadu South India

Boon Allwin[1*], M.G. Jayathangaraj[1], M. Palanivelrajan[1], S. Gomathinayagam[2], M. Raman[3] and S.T. Bino sundar[2]

[1]Department of Wildlife Science, Madras Veterinary College, Chennai, India.
[2]Department of Veterinary Parasitology, Madras Veterinary College, Chennai, India.
[3]Programme director, TRVPB, TANUVAS, Chennai, India.

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Study on endoparasites in wild pigs (*Sus scrofa*) interfering with agriculture, was carried out in areas adjoining the Western Ghats (Mudumalai tiger reserve, Anamalai tiger reserve) and Eastern Ghats (Sathyamangalam region) of Tamil Nadu state in India during November, 2013 to May, 2014. Ninety faecal samples in total (n=30 of Wild pigs, n=30 of Desi pigs and n=30 Cross bred pigs each of the study areas) were subjected to the parasitological examination using standard methods in wild pigs as well as in domestic pigs. Domestic pigs were involved to find the difference in the prevalence level between wild pigs and domestic pigs as there is a wide variation in their habitat. Prevalence of endoparasitic infections revealed the evidences of *Ascaris suum, Trichuris suis,* Strongyles, *Strongyloides* sp. and mixed parasitic infections comprising of *Ascaris* sp. with *Trichuris* sp., in addition to Strongyles with *Strongyloides* sp. The overall positivity of internal parasitic prevalence in wild pigs, desi pigs and cross bred pigs pertaining to Mudumalai, Anamalai and Sathyamangalam were documented, and differences among their prevalence data indicated an over-dispersed helminth distribution. These results indicate that populations of wild pigs although living under optimal conditions, are heavily affected by a burden of parasitic disease and some parasites are likely to limit population growth via a high mortality of piglets and infections throughout the lifespan of adults.

Key words: Wild pigs, domestic pig, endoparasites, prevalence.

INTRODUCTION

Although, the helminth parasites of domestic pigs are well documented there is paucity of information with regard to

*Corresponding author. E-mail: boonallwin@gmail.com.
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wild pigs. In wild populations there is usually a balanced host-parasite relationship, but pathogenicity. However, anthropogenic changes of the environment, the increase of human populations and the introduction of other animal species, may introduce unknown factors that can disrupt the natural balance and induce pathological conditions. This study is a contribution to the knowledge of wild pig helminthic fauna as these animals have been co-inhabiting with human beings and domestic pigs sharing the same resources such as land, water and also air. The epidemiology of parasitic diseases is very important as they have a zoonotic potential that can lead to various deleterious effects. In this study, a comparison of the prevalence rate of various parasitic infections in wild pigs, desi pigs and cross bred pigs have been recorded by standard techniques like floatation and centrifugation and their Egg Per Gram (EPG) was constituted to know the intensity of the infections.

MATERIALS AND METHODS

Study area

The study on endoparasites in wild pigs (*Sus scrofa*) interfering with agriculture was carried out in areas adjoining the Western Ghats (Mudumalai tiger reserve, Anamalai tiger reserve) and Eastern Ghats (Sathyamangalam region) of Tamil Nadu state in India during November, 2013 to May, 2014.

Collection and preservation of coprological samples for endoparasitic examination

Throughout this study programme, 30 fresh faecal samples of wild pigs from described sampling areas were collected in small containers with 10% formalin for parasitic examination, and were properly labelled and sealed with parafilm subsequently. The wild pigs were tracked by foot and their locations and resting nests were identified by their field signs (Boon et al., 2015). Similarly, 30 faecal samples from desi-pigs that are semi-free ranging and 30 faecal samples from cross-bred pigs that were maintained in organised farms were collected and processed.

Examination of samples

The faecal samples were processed by both centrifugal sedimentation technique and floatation technique as described by Soulsby (1982).

Centrifugal sedimentation technique

Approximately 2 g of faeces was taken in a 100 ml beaker and was thoroughly mixed with about 10 to 15 ml of tap water. The mixture was strained through a tea strainer into a cup and then, it was transferred into a centrifuge tube. The centrifuge tubes were placed in a balanced state and were subsequently centrifuged for 2 to 4 min, at 1500 rpm. Then, the supernatant was discarded leaving 1 to 2 ml of supernatant, without disturbing the sediment at the bottom and finally, small drop from thoroughly homogenized sediment was taken on clean glass slide and was observed under both low and high power objectives of microscope (Soulsby, 1982).

Floatation technique

Faecal samples were taken in a 100bml beaker and were thoroughly emulsified with about 10 to 15 ml of saturated solution of sodium chloride with a specific gravity of 1.18 to 1.20. The mixture was strained into a cup and then, it was transferred into a floatation tube till the mixture reaches the brim of the tube and forms a positive meniscus and was left undisturbed for 15 to 20 minutes. The tip of the positive meniscus was gently touched with a clean cover slip and then the cover slip was placed on a slide, and was examined microscopically under both low and high power objectives (Soulsby, 1982).

Quantitative analysis

One gram of faecal sample was mixed with 4 to 5 ml of saturated solution of sodium chloride and was strained trough tea-strainer into floatation tube and volume was adjusted up to 12 ml with saturated salt solution and kept for 20 min undisturbed. From this, 0.3 ml of suspension was added to McMaster slide chamber and the eggs were counted and multiplied by 40 and thus, the number of eggs per gram of faeces was calculated.

STATISTICAL ANALYSIS

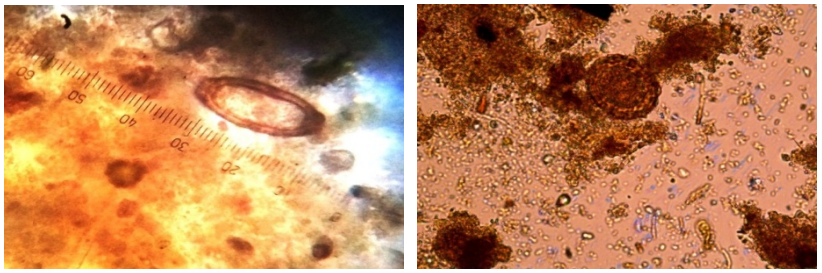
The statistical analysis of the data was carried out as per the guidelines, using one way ANOVA, wherever applicable.

RESULTS

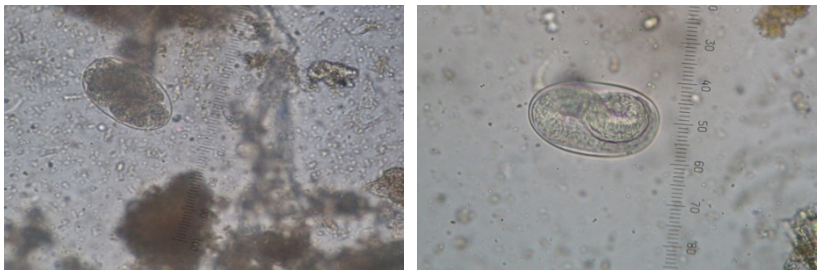
Evidence of endoparasitic fauna was recorded in free ranging wild pigs as well as domestic pigs, comprising of desi pigs and cross bred pigs. *Ascaris suum, Trichuris suis*, Strongyles, *Strongyloides* sp. and mixed parasitic prevalence comprising of *Ascaris* sp. with *Trichuris* sp. in addition to Strongyles with *Strongyloides* sp. were documented during the study programme with all these pigs with a varying level of intensity that was high in wild pigs, moderate in desi pigs and negligible in cross bred pigs (Figure 1).

Prevalence of endoparasites with regard to different internal helminthic fauna of wild pigs, desi pigs and cross bred pigs pertaining to adjoining areas of Mudumalai, Anamalai, and Sathyamangalam wildlife regions were presented in Table 1 to 3. Positivity for internal parasitic prevalence with regard to wild pigs, desi pigs and cross bred pigs were 62, 29 and 9% respectively (Figure 2).

The EPG values pertaining to the parasitic prevalence comprising of *A. suum, T. suis*, Strongyles, *Strongyloides* sp. and mixed parasitic prevalence comprising of *Ascaris* sp. with *Trichuris* sp. in addition to Strongyles with *Strongyloides* sp. in wild pigs, desi pigs and cross bred pigs were presented in Table 4. The mean ±S.E. values of EPG among wild pigs, desi pigs and cross bred pigs with regard to individual endoparasitic species during this study in different adjoining areas of different wildlife regions were documented in Table 4. Highly significant variations ($P \leq 0.01$) were encountered with regard to *A. suum, T. suis,* Strongyles in Mudumalai regions, and with



(A) Egg of *Trichuris suis* 40X (B) Egg of *Ascaris suum* 40X



(C) Egg of Strongyles 10X (D) Egg of *Strongyloides* sp. 40X

Figure 1. Endoparasites of wild pigs.

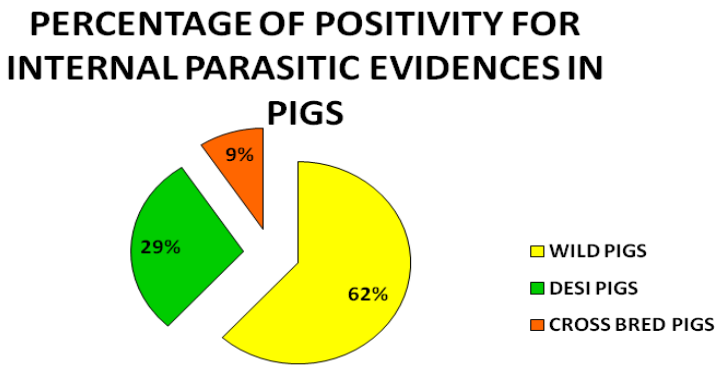


Figure 2. Parasitic evidence in pigs.

regard to *A. suum* in Sathyamangalam region. Similarly, significant variations (P≤0.05) were encountered among these pigs with *A. suum* in Anamalai region, and also with regard to mixed parasitic infection comprising of *Ascaris* sp. with *Trichuris* sp. among the pigs in Mudumalai region.

DISCUSSION

Parasitic prevalence

Overall parasitism in wild pigs and other pigs

The overall parasitic prevalence pertaining to the internal parasites in wild pigs (Figure 2) was found to be 62% wild pigs, 29% in desi pigs and 9% in cross bred pigs. Even though literatures pertaining to the occurrence of internal parasites in domestic swine are more, there is paucity of information in helminthic fauna of wild pigs in general. The parasitic eggs in this study were identified based on the morphological keys furnished by Encountering the increased percentage of parasitic prevalence in the samples from wild pigs which was supported by the report furnished by Jarvis et al. (2007) who quoted that none of the 25 examined carcasses of wild boars from Central Spain and those imported from France was free of helminths. Similarly, Eslami and Hamdi (1992) opined that the majority of wild boars examined (74%) had at least one species of helminth in the internal organs, and

Table 1. Prevalence of endoparasitic infections of wild pigs (n=30).

S/N	Parasites	Places under study		
		Mudumalai (%)	Anamalai (%)	Sathyamangalam (%)
1	*Ascaris suum*	8 (80)	8 (80)	7 (70)
2	*Trichuris suis*	6 (60)	7 (70)	8 (80)
3	Strongyles	7 (70)	6 (60)	7 (70)
4	*Strongyloide*s sp	7 (70)	6 (60)	5 (50)
5	Mixed infections (*Ascaris +Trichuris)*	8 (80)	7 (70)	7 (70)
	Strongyle+Strongyloides	4 (40)	3 (30)	2 (20)
Total number of faecal samples examined		10	10	10

Table 2. Prevalence of endoparasitic infections of desi pigs (n=30).

S/N	Parasites	Places under study		
		Mudumalai (%)	Anamalai (%)	Sathyamangalam (%)
1	Ascaris suum	5 (50)	4 (40)	4 (40)
2	Trichuris suis	5 (50)	4 (40)	4 (40)
3	Strongyles	4 (40)	3 (30)	2 (20)
4	Strongyloides sp	3 (30)	4 (40)	1 (10)
5	Mixed infections *(Ascaris +Trichuri)*	4 (40)	2 (20)	1 (10)
	Strongyle+Strongyloides	2 (20)	1 (10)	NIL
Total Number of faecal samples examined		10	10	10

Table 3. Prevalence of endoparasitic infections of cross bred pigs (n=30).

S/N	Parasites	Places under study		
		Mudumalai (%)	Anamalai (%)	Sathyamangalam (%)
1	Ascaris suum	2 (20)	1 (10)	2 (20)
2	Trichuris suis	2 (20)	1 (10)	1 (10)
3	Strongyles	2 (20)	1 (10)	0
4	Strongyloides sp	1 (10)	1 (10)	2 (20)
5	Mixed infections *(Ascaris +Trichuris)*	NIL	1 (10)	NIL
	Strongyle+Strongyloides	NIL	NIL	NIL
Total Number of faecal samples examined		10	10	10

parasitic infections with several species were common in the wild boars. Further, encountering the increased overall positivity of parasitic prevalence in the wild pigs under study was in argument with the reports furnished by Bhat and Manickam (1998) who opined that high faecal egg counts were common in free ranging animals' state than those living in captivity.

Similarly, when compared to the overall parasitic prevalence between desi pigs and the cross bred pigs of the adjoining areas studied; the percent prevalence of helminthic fauna was more in the case of desi pigs. The reasons for such an intensive prevalence of helminthic fauna in case of desi pigs might be assigned to the lesser veterinary care, straying of desi pigs outside consuming different kinds of intermediate hosts like earthworms, small sized reptiles or other creatures in or around the drainage areas noticed in the adjoining areas of wildlife regions. Comparatively, due to a better management

Table 4. Mean±standard error value of egg per gram of faeces in the different pigs.

S/N	Endoparasitic infection		Mudumalai	Sathyamangalam	Anaimalai
1	*Ascaris suum*	Wild pig	756.25±57.82^{b}	575±31.34^{a}	664.29±84.34
		Desi	650±74.36^{b}	575±59.51^{ab}	412.5±82.60
		Cross bred	125±25.00^{a}	100±0.00^{b}	125±25.00
		F value	12.845**	10.680**	6.558*
2	*Trichuris suis*	Wild pig	225±21.41^{b}	221.43±18.45	206.25±19.91
		Desi	290±18.76^{b}	250±20.4	225±12.5
		Cross bred	125±25.00^{a}	100±0.00	100±0.00
		F value	9.073**	4.201^{NS}	2.126^{NS}
3	Strongyles	Wild pig	214.29±14.29^{a}	166.66±21.09	164.29±21.03
		Desi	77.5±30.38^{b}	100±28.87	125±25.00
		Cross bred	75±25.00^{b}	50±0.00	50±0.00
		F value	14.643**	3.230^{NS}	2.195^{NS}
4	*Strongyloides* sp	Wild pig	150±22.01	133.33±18.26	160±12.95
		Desi	100±25.00	137.5±21.35	100±0.00
		Cross bred	100±0.00	50±0.00	75±25.00
		F value	1.018^{NS}	0.875^{NS}	1.469^{NS}
5	*Ascaris* sp +*Trichuris* sp	Wild pig	137.5±15.67	142.86±17.01	118.75±16.02
		Desi	150±20.41	125±53.03	150±0.00
		Cross bred	Nil	Nil	Nil
		F value	5.051*	2.672^{NS}	3.411^{NS}
6	*Strongyle* sp+*Strongyloides* sp	Wild pig	75±14.43	133.33±33.33	125±25.00
		Desi	125±25.00	150±0.00	Nil
		Cross bred	Nil	Nil	Nil
		F value	5.619^{NS}	2.300^{NS}	6.250^{NS}

Means bearing different superscript differ significantly (NS-Non Significant).

system that includes provision of required health care measures, maintenance of good feeding regime, feeding based enhanced immune status of the animal etc. while the overall prevalence in the case of cross bred pigs was found to be less than 9%.

The reasons for encountering higher percentage of overall positivity of parasitism in wild pigs might be assigned to the reasons like diversified feeding activities of the animals, straying into the peripheral-areas of the wild regions, consumption of different types of intermediate host, absolute lack of health care related measures, consumption of feed materials contaminated by excreta of the co-existing wild animals like gaur, nilgiri tahr, spotted deer and sambar deer that co-exist in the wild environment etc. Different types of management patterns, variations in feed offered, extent of health care measures like deworming activities, varying immune status of the swines might be the reasons that could be attributed to the variation in the positivity of parasitism in desi as well as the cross bred pig of the adjoining areas studied. However, since wild pigs entering the agricultural fields adjoining those regions in the study are basically wild in nature with more or less similar type of feeding activities, wild pigs of all these regions were found to have higher percentage of overall parasite prevalence with values of 90% and above, and this could be a potential source of transmitting infection to the domestic pigs. Further, the encountering of increased overall parasitic prevalence in wild pigs under study was in agreement with the report given by Jarvis et al. (2007) who opined that the natural peculiarities of the area, including the sufficient availability of intermediate hosts of helminths were the important factors that affected wild pigs with helminths.

Parasitic prevalence in different adjoining regions and the intensity of infection

The percentage of positivity pertaining to different parasitic fauna encountered in wild pigs,desi pigs and cross bred pigs are presented in Tables 1 to 3. *A. suum* and *T. suis* were the frequently encountered parasitic

fauna, with wild pigs in general. The EPG values of *A. suum,* in case of wild pigs as well as desi pigs differed highly significantly when compared to the value encountered in case of cross bred pigs in Mudumalai as well as Sathyamangalam area. Similarities in certain feeding related activities, varying immune status of pigs etc. might be assigned as the etiological factors pertaining to such highly significant variations in them.

In this regard, it was noteworthy to mention the report furnished by Tiwari et al. (2009) who quoted that in Botswana, *A. suum* was the most prevalent helminth encountered in the case of pigs. Further variations in the number of wild pigs affected with *A. suum* was encountered in this study was supported by Foata et al. (2005) who opined that among the numerous most often cited in the literature, *A. suum* was found to be one of the only three parasitic species that were index at the time of their study in case of wild boars. Variations in EPG values pertaining to the *A. suum* as encountered in the wild pigs as well as in others was further in agreement with the findings revealed by Popiolek et al. (2010) who further stated that though the *A. suum* was common in pigs and wild boars worldwide, the level of wild boar infection was not very high. In this regard, Tomass et al. (2013) quoted that *A. suum* was the most common helminth in all age categories of pigs and *Ascaris suum* was a natural parasite of pigs as it could also infect human, and the potential of the *A. suum* to infect human might be due to the fact that it stored similar protein molecular with *A. lumbricoides* for which man is the natural host. Urquart et al. (1996), also quoted that the eggs pertaining to *A. suum* were very resistant to extreme temperature and the eggs of *A. suum* were found to be viable for more than four years.

Encountering *A. suum* in domestic pigs as noticed with desi as well as cross bred pigs under study, was in agreement with the findings presented by Radostitis et al. (2007) and Urquart et al. (1996). Encountering *T. suis* in the wild pigs in this study was in agreement with the report furnished by Jarvis et al. (2007) who revealed that though, *T. suis* was noticed as one of the seven helminth species in wild boars. During this study, the EPG value pertaining to wild pigs as well as the desi pigs were found to be significantly different, when compared with the values encountered with cross bred pigs in Mudumalai region alone. The different types of management systems that are maintained with the cross bred pigs including the reasonably intensive health care related measures lack of opportunities for the consumption of diversified types of feeds including different types of intermediate hosts etc. might be assigned as the etiological factors for the encountering of highly significant variations in the EPG values of *T. suis* in the case of cross bred pigs when compared to that of wild pigs as well as desi pigs. Encountering the *T. suis* as noticed in the studyis also in agreement with the report presented by Tomass et al. (2013). It becomes noteworthy to mention the report presented by Nansen and Roepstorff (1999) who opined that often moderate numbers of adult *T. suis* were present in the caecum and colon, and if there was high prevalence of *T. suis* infections in the swines, it might lead to unthriftiness and death, and it was demonstrated that severe clinical disease might be associated with *T. suis* induced suppression of mucosal immunity to resident bacteria.

The EPG value of strongyles in wild pigs was found to be 214.29±14.29, where it was 77.50±30.38 in desi pigs and 75.00±25.00 in cross bred pigs. Findings on the prevalence of strongyles in wildlife under study was in agreement with the report presented by Souse et al. (2004) who encountered presence of gastrointestinal strongyles eggs in all the faecal samples of wild boars examined and further quoted about the average EPG of 2142 in the case of gastrointestinal strongyles in wild pigs when compared to the EPG values of desi pigs, in addition to the cross bred pigs which might be attributed to the existing different kinds of biotic as well as the abiotic environmental factors. The encountering of prevalence of strongyles was further in agreement with the report furnished by Magi et al. (2005)

The EPG values of *Strongyloides* sp. were presented in Table 4 and however, there was no statistical significance among the pigs comprising of wild pigs, desi pigs and cross bred pigs. Encountering the *Stronglyloides* sp. with pigs under this study was in agreement with the findings reported by Varadhrajan and Pythal who however, encountered mixed infection associating with *Fasciola* sp., Strongyles and *Strongyloides* sp. in wild boars. In this regard, Tiwari et al. (2009) quoted that parasitic fauna like *Strongyloides* sp. were found to be related to the occurrence of clinical signs like diarrhoea as well as emaciation in pigs. With regard to encountering the prevalence of *Strongyloides* sp. in this study, Coombs and Springer (1974) opined that since wild pigs were associated with feeding of earthworms, beetles, bugs and numerous larvae which functioned intermediate or paratenic hosts for various helminthic fauna, more helminth fauna were encountered including the *Strongyloides ransomi*. Urquart et al. (1996), reported the experimental demonstration of prenatal infection associated with *Stronglyloides* sp. in pigs.

Conclusion

Even though increased parasitic prevalence was encountered in the faecal samples of wild pigs entering the agriculture fields near wildlife regions, immediate conclusion about the existence of a clinical disease condition could not be drawn. Many factors may be involved and lack of extensive studies pertaining to the parasitic fauna in both core and buffer zone areas of wildlife regions. However, it might be understood that wild pigs revealed existence of different helminthic fauna

comprising of *A. suum, T. suis,* Strongyles, *Strongyloides* sp. and mixed parasitic infections associated with *Ascaris* sp. with *Trichuris* sp., in addition to Stongyles with *Strongyloides* sp. Availability and feeding of diversified feed materials which comprises of earthworms, beetle larvae, insects, small rodents, egg and chicks of birds nesting on the ground as well as in short grass, including the feeding of carrion sometimes might be the significant factors that lead to the encountering of different parasitic fauna in the wild pigs studied. The encountering of significant variations in the mixed parasitic prevalence associated with *Ascaris* sp. and *Trichuris* sp. might be attributed to differences in feed materials consumed, variations in the immune level, management practices etc. The finding of the presence of endoparasites in wild pigs will be helpful in designing strategy management practices and curbing the disease at the initial levels and this can be done with ease.

Conflicts of interest

The authors declare that they have no conflicts of interest.

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Full Length Research Paper

Urinary schistosomiasis: Water contact frequency and infectivity among school aged pupil/students in Umukabia Community of Ehime Mbano Local Government Area of Imo State, Nigeria

Iwu, R. U.*, Azoro, A. V. and Onuoha, J. N.

Department of Biology, Alvan Ikoku Federal College of Education, Owerri, Nigeria.

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A study was conducted among 108 students and pupils of four selected schools in Umukabia Community in Ehime Mbano Local Government area of Imo State, Nigeria using their activities at Efuru and Okparadibia streams. Structured questionnaire was used to elicit information on water contact frequency and aetiology of the disease. *Schistosoma haematobium* ova detection was achieved by the microscopy. Results revealed that there was no significant difference in prevalence of S. *haematobium* between the students and pupils of the schools but there was a significant difference in prevalence of the infection among the males and females. It is therefore recommended that boreholes should be sunk in the community, the streams be treated with mullucides to reduce the snail population, and recreational facilities be provided in schools to dissuade children from going to play in infected streams. Finally, health awareness seminar should be intensified to create awareness of the mode of transmission of the parasite.

Key words: Schistosomiasis, water contact, mullucides.

INTRODUCTION

Schistosomiasis is one of the neglected tropical diseases in Nigeria, which continues to plagues inhabitants of rural and peri- urban areas where there is inadequate sanitation and poverty. Over 600million people worldwide are exposed to the risk of infection, especially those who perform daily water- related activities in snail infested water bodies (Etim et al., 2012). Urinary schistosomiasis is a chronic disease caused by digenetic trematode, *Schistosoma haematobium*. (Akinboye et al., 2012). The snail intermediate host is an aquatic plunomate belonging to the family planorbidae (Ukoli, 1990).

S. *haematobium* was originally a disease of Africa which has spread to other continents with the advent of the massive exodus of slaves in the 17th and 18th centuries. S. *haematobium* is endemic in fifty-four countries of Africa and Middle East (WHO, 1993). The occupation of people predominantly affected by S.*haematobium* are farming and fishing. This is

*Corresponding author. E-mail: rosemaryiwu13@ymail.
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Table. Number and percentage of students and pupil infected with S. *Haematobium* in the four schools.

Name of school	Male		Female		Total	
	NE	NI (%)	NE	NI (%)	NE	NI (%)
Community Secondary Umuodu	28	03 (10.7)	13	01 (7.6)	41	04 (9.7
St. Michael's Primary School	07	01 (14.2)	12	1 (0.00)	20	02 (10.0)
Community Primary School Umuodu	11	02 (18.1)	15	01 (6.6)	26	03 (11.5)
City Commercial School	04	(0.00)	18	01 (5.5)	22	01 (4.5)
Total	50	06 (12.0)	58	03 (5.1)	108	10 (9.2)

N=Number E= Examined I= Infected

further compounded by the poor sanitary conditions allied to practices as urinating in ponds, rivers and streams, which are used as population's water supply and water-related activities like swimming, sand digging, washing of house-hold chores, bathing amongst others (Iwuet al., 2006a).

The transmission of urinary schistosomiasis is contingent to the presence of the infected snail host in water or by direct contact with human population. The distribution is focal, and its effects are more felt in the rural areas of the tropics where the population lives in natural fresh water habitats using the water for domestic water supply and agriculture (Iwu et al., 2006b).

The disease is also associated with water resource developmental projects like irrigation schemes, slow-flowing or stagnant water where the inter mediate host breeds. These results in infection of people who use the traditional methods such as wading in the water, vegetable cultivation at river banks during dry season, plant and harvest rice or catching fish as a recreational activity. In the studies carried out independently by Ofoezie (2002), Hunter (2003) and Simon and Benhamou (2009) that there were increased rates of infection due to exposure patterns associated with bathing or washing, farming along rivers and canals harboring infected snail hosts. People become infected with S. *haematobium* when the cercaria, which is the infective form of the parasite, penetrates the skin and enters the circulatory system after becoming paired in the various vessels, reaches the veins of the bladder and are referred to as "copula". Parasites can lay their eggs up to five years (Newport and Agbabian, 1990). The eggs are excreted in the urine of infected persons, into water bodies and develops into a ciliated miracidia, which swims in water and penetrates the snail, developing into cercaria form. This new form can emerge from snails and penetrate in the human's skin starting a new cycle (Chessburgh, 1987).

Many school aged children often stop by streams to swim or "cool off", fish or wash their dirty chores, thus the study aims at examining the effect of water contact frequency on the prevalence of urinary schistosomiasis and infectivity in streams in Umukabia Community of Ehime Mbano LGA. The target respondents in schools are located at varying distances from the streams which determine the frequency of contact, students had with the stream.

METHODOLOGY

The study was conducted from January to November, 2012. Students from two secondary schools and two primary schools in Umukabia formed the study population. The Efuru stream is located along Mgboroko and Umualunwoke village while Okparadibia stream is in Umuobi both in Umukabia. The streams were selected due to their varying degree of accessibility to students and pupils of the four schools in the study. A total of 108 urine samples were collected from the students/pupils of the four schools as follows: 45 urine samples (28 males and 13 females) from Community Secondary school Umukabia, 19 urine samples from St. Michaels' primary school Umuezeala(7 males and 12 females), 26 urine samples from Community Primary school Umuodu (11 males and 15 females) and 22 urine samples from City Commercial Secondary School (4 males and 18 females).

Urine sampling

Urine samples were collected using 15 ml sterile sampling bottles covered with lids. This was done between 10.00 am and 1.00 pm a time reported to produce maximum egg output (Pugh and Gilles, 1978). Also, a structured questionnaire was administered to each subject to elicit information on the aetiology of the disease.

Schistosoma haematobium ova detection by microscopy

10 ml of each of the urine sample was centrifuged at 3000 r.p.m for 5 min. The supernatant was decanted, while the sediment was spread on a slide and covered with a cover slip, after which it was examined under the microscope, using the ×10 eye piece and ×40 objectives for the presence of S.*haematobium* ova. The quantity of eggs found were determined and expressed as number of eggs per 10 ml of urine (egg/10 ml). The infection was designated low, if the egg count was less than or equal to 50 eggs/10 ml (WHO, 1993).

RESULTS

A total of 108 people were examined, comprising of 50 males and 58 females. Out of which 6 (12.0%) males and 3 (5.1%) females were found to be positive for ova of S. *haematobium* (Table 1). Prevalence of *S. haematobium*

Table 2. Age and sex related prevalence of urinary schistosomiasis among students in sampled schools.

Age group	Male		Female		Total	
	NE	NI (%)	NE	NI (%)	NE	NI (%)
6-8 years	04	01 (25.0)	08	01 (12.5)	12	02 (16.67)
9-11 years	16	01(6.25)	19	03 (15.78)	35	04 (11.42)
12-14 years	23	02 (8.69	24	05 (20.83)	27	07 (25.92)
15-17 years	07	01 (14.28)	07	00 (0.0)	14	01 (7.14)

Table 3. Water constant frequency.

Number of times in contact with the stream daily	Sex		Total number of subjects
	Male	Female	
0	10	15	25
1	27	29	56
2	13	10	23
3 and above	-	4	04

Table 4. Awareness of the actiology of the disease among students in the study area.

Aetiology	Sex		Total number of subjects (frequency)
	Male (%)	Female (%)	
Insect bite	14 (28.0)	10 (17.2)	24
Contact with infected person	08 (36.0)	24 (24.1)	32
Playing and washing in infected water body	09 (18.0)	21 (36.2)	30
Drinking contaminated water	09 (18.0)	13 (22.4)	22
Total	50 (100)	58 (99.9)	108

was higher among 6 to 8 years old in males and 12 to 14 years old in females (Table 2). Table 3 shows that females visit the streams more frequently than the males. The questionnaire analysis revealed that some females and males knew that playing and washing in infected water bodies was the cause of the infection depicting 36.2% and 18.0% respectively. Other sources of the infection suggested include insect bite, contact with infected person and/or drinking contaminated water meaning that the aetiology of the disease varied among the subjects (Table 4).

DISCUSSION

The overall prevalence rate of 9.2% of urinary schistosomiasis discovered in the study is low when compared to 91% prevalence observed by Gilles et al. (1965) in Ibadan, and 90 to 100% prevalence rate reported by Edungbola (1980) in Ilorin, Kwara State, Nigeria showing a variation in prevalence of schistosomiasis from one locale to another. Also, 37.82% prevalence rate was observed among primary school children in Ikwo, Ebonyi state (Iwu et al., 2006a, b), and 52.2% in Sokoto (Bello et al., 2003).

However, the current prevalence rate of 9.2% observed in the present study is higher than the 7% prevalence rate observed in Ibadan by Akinkugbe (1962), or 2.8 and 1.5% in Aguata and Imo state respectively by Ukpai and Ezeike (2002), Nnoruka (2000). The low prevalence rate might be related to continuous dredging of the streams, and improved knowledge and awareness about the disease.

Sex and age related prevalence showed that more of the males within the age range of 6 to 8 years play more often in streams than their female counterparts. Among the females age group, 12 to 14 year old was more infected than others, this is similar to the findings among secondary school students in Ibadan by Akinboye et al. (2012), and school children in Malumfanshi (Pugh and Gilles, 1978). The decline observed among the females within 15 to 17 years was previously observed by Lwanbo (1988), and was attributed to their knowledge of the aetiology of the infection and their ability to take

appropriate precaution to avoid contamination. Also observed in this study, was that more females tend to visit water bodies once a day either to wash their body or chores thereby infecting themselves. This is in line with the previous reports in Ikwo, Ebonyi State where more females frequent streams to process breadfruit, fetching water for domestic use, wash cloths amongst others than their male counterparts as reported by Iwu et al. (2009), but differs from results obtained by Ukpai and Ezeike (2002), Dunah and Bristone (2000), Akogun and Akogun (1996) and Guyral and Vaz (2000) where frequency of water contact activities had been found to be positively associated with both prevalent and intensity of urinary schistosomiasis.

CONCLUSION AND RECOMMENDATION

The study revealed a low prevalence of urinary schistosomiasis, however there is need to enhance health education programs among school children, who are ignorant about the mode of transmission despite their knowledge of the disease. Also, most of the subjects encountered in the study did not know much about the life cycle, and how their activities in the environment enhance the life cycle of the parasite. There is an urgent need to treat Efuru and Okparadibia streams with effective mulluscide to reduce the snail population which is the intermediate host of the parasite. Finally, the primary schools located close to the stream should be provided with recreational facilities to dissuade children from going to play in infected streams.

Conflicts of interest

The authors declare that they have no conflicts of interest.

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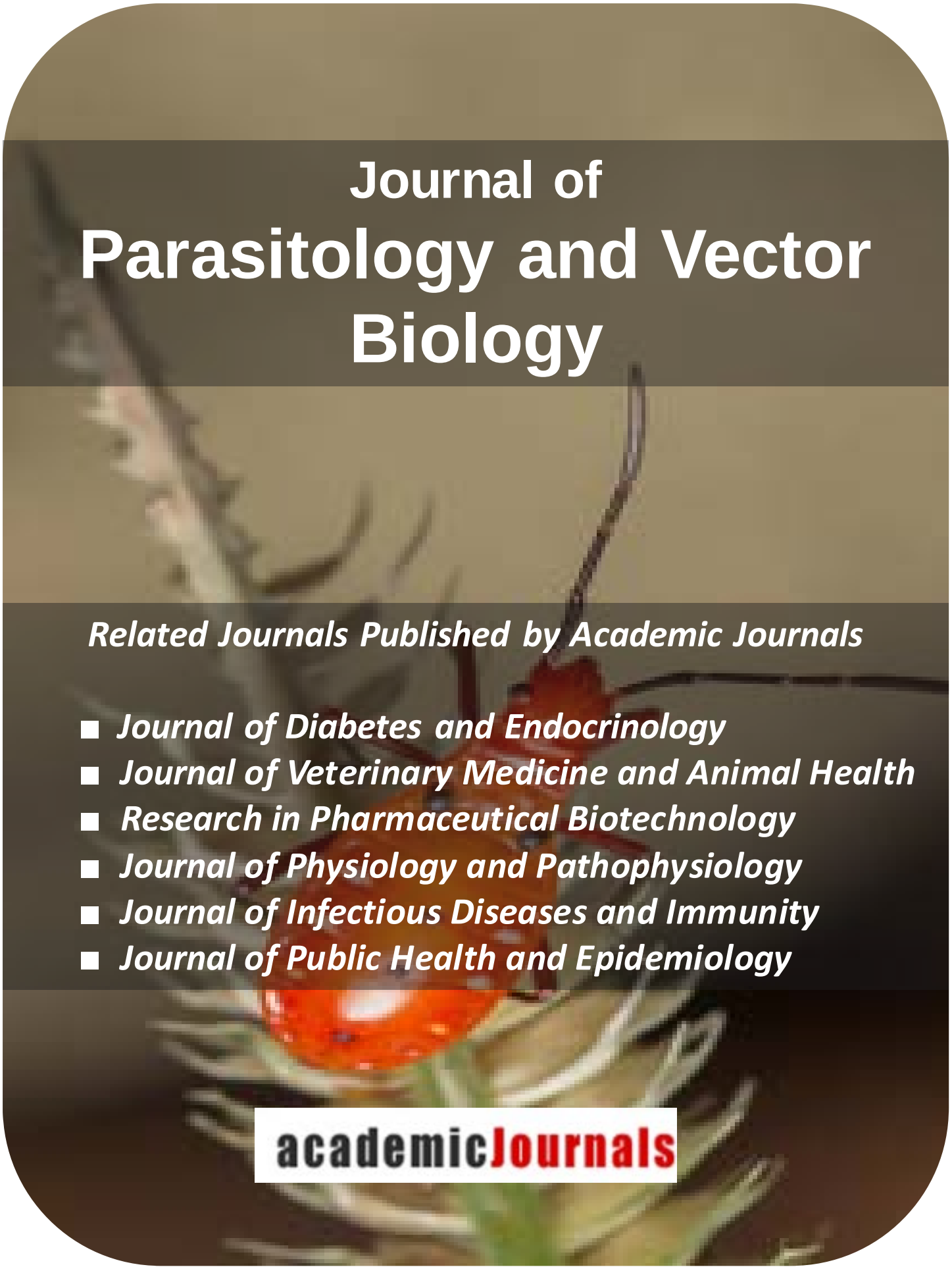
APPENDIX QUESTIONNAIRE

1. How many times do you visit the stream/river/swampy area in a day?
(a)Once (b) twice (c) thrice and above.
2. The activities that get you in contact with water bodies are
(a) Bathing (b) swimming/cooling off (c) washing of clothes/ household chores
(d) fishing/sand digging.
3. Urinary schistosomiasis can be contacted through?
(a) Insect bite (b) contact with infected person (c) playing and washing in infected water body (d) Drinking contaminated water.



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