HETEROGENEITY IN MORPHOMETRIC PARAMETERS STUDIES OF ASCARIS LUMBRICOIDES IN RELATION TO ITS EFFECTS IN INFECTED PRIMARY SCHOOL CHILDREN IN THREE LOCAL GOVERNMENT AREAS OF OGUN STATE, SOUTH-WESTERN NIGERIA

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ABSTRACT: Morphometric studies were carried out on Ascaris lumbricoides recovered after Antihelminthic Levamis (400 mg Levamisole) treatment of 960 school children in Ewekoro, Ado-odo-Ota and Ogun- Waterside Local Government of Ogun State, Nigeria. 986 worms were expelled, of which 613 (62.17%) were female worms and 373 (37.83%) were male worms. An overall average maximum length of 39.70 cm and weight of about 10.37 g and an average minimum length of 8.50 cm and weight of about 0.16 g were obtained. Total mean length and weight were obtained as 8.8 ± 3.14 and 10.13 ± 5.52 for female worms, and 5.33 ± 2.98 and 6.38 ±4.56 for male worms, respectively in all the three local governments. Analysis of variance (P < 0.05) revealed a significant difference in the measurement by length and weight of female and male Ascaris across the three local governments. The pattern of frequency distribution of length and weight showed a high length and weight measurement class between 12.00 and 23.99 cm and 1.10 and 11.09 g, respectively. This may be responsible for physical effects, such as diarrhoea, abdominal pains, nausea and loss of appetites. However, high frequency of measurement observed across the local government areas of Ogun State may be due to health status, low level of hygiene, socio-cultural activities and occupation of people in these local government areas.

INTRODUCTION

Gastrointestinal helminthiasis constitute a major health problem in developing countries, including Nigeria, and remain among the most prevalent of human infection being responsible for much morbidity and some mortality (Ogbe and Adu, 1990; Agi, 1995; Adelioye et al., 2011; Odu et al., 2011a; Odu et al., 2013). Ascaris is even at present one of the important helminthiasis all over the world (WHO, 2006).

Two primary factors in maintaining endemicity of intestinal helminthes infections are favourable quantities of the soil and frequent contamination of the environment by human faeces (Sam-Wobo et al., 2005; Jimenez-Gonzalez et al., 2009; Odu et al., 2011b; Emmy-Egbe et al., 2012). Transmission within the community is predominantly related to human habits with regards to eating, defecation, personal hygiene, cleanliness and level of education (Ibidapo and Okwa, 2008; Chijioke et al., 2011). Ascariasis has been known to be responsible for physical effects which may include diarrhoea, abdominal pains, nausea, loss of appetites and even migratory larvae that causes hemorrhage (Edungbola and Obi, 1992). Previous studies on association of Ascaris infection in relation to diarrhoea, abdominal pains, nausea, loss of appetites and other physical effects among school children in Nigeria have been reported by Mordi and Ngwodo, (2007); Ajero et al., (2008); Okolie et al., (2008); Chukwuma et al., (2009); Awolaju and Morenikeji, (2009); Alli et al., (2011a); Alli et al., (2011b); Odu et al., (2011a); Odu et al., (2011b); Odu et al., (2013).

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Many effective control measures have provided substantial benefits in reducing the abundance with an affordable chemotherapy (Albendazole, Membendazole and Levamisole) (Sam-Wobo and Mafiana, 2005; WHO, 2006; Odu et al., 2011a; Usip et al., 2013). The prevalence and incidence of Ascaris is much higher than other intestinal helminthes, Trichuris trichuria, hook worms which are more common in mixed infection (Mafiana et al., 1998; Okonko et al., 2009; Alli et al., 2011a; Sam-Wobo, et al., 2012; Alo et al., 2013; Atting et al., 2013; Banjo et al., 2013; Lorina, 2013; Usip et al., 2013). Observations from field data in the range of geographically distinct human communities showed that variability depends on the level of infection in the community and geographical differences in the host or parasite population, which suggest that there is no statistical significant difference between males and females to intestinal helminthes infection (Mafiana, 1995; Agbolade et al., 2004; Sam-Wobo and Mafiana, 2005). The homogeneity of the size of individual worms found in heavy Ascaris infections in humans has led to the hypothesis that newly acquired worms cannot mature while there is an established worm burden present in the gut that interfere with further recruitment of juveniles. Reports have shown that length and weight of Ascaris depend on the rate of infection, re-infection, number of treatment time and type of chemotherapy such children are exposed to (Forrester and Scott, 1990; Fashuyi, 1992). Studies have revealed that morphometric parameters have an adverse effect on nutritional status, physical, cognitive, educational and societal development of the school children (Forrester and Scott, 1990; Sam-Wobo et al., 2005; Sam-Wobo et al., 2007, Sam-Wobo et al., 2008; Prosper et al., 2014). Therefore, there is a necessity for provision of antihelminthic drugs, preventive measures and control against helminthiasis among school children since they are at risk of Ascaris infection. The main objective of this study was to compare the relationship between morphometric features among sexes in relation to their effect on the pupils.

**MATERIALS AND METHODS**

2.1. Study Area

The study areas are three local government areas of Ogun State, Nigeria, which are selected based on their physio-chemical properties (Mafiana et al., 1998; Sam-Wobo and Mafiana, 2005) (Ewekoro, Ado-odo-Ota and Ogun-Waterside); a tropical rain forest zone lies approximately between longitude 2 30’W and 4 30’E, latitude 6 30’S and 8 N. It is bounded in the south partly by the Atlantic Ocean and sharing common boundaries with Oyo and Ondo States. It has an area of 16,369 square/km with population of about 7.5 million (2003 census estimation) and are predominantly Yoruba speaking tribe of Nigeria whose traditional occupations are farming and commerce. The study areas were mapped using the soil-geographical map of Ogun State (Mafiana et al., 1998) (Figures 1 and 2).

![Figure 1: Map showing Ogun State (in red), Nigeria.](image-url)
2.2. Ethical Consent and Approval
Ethical consideration for the study were also observed, consent and approval were obtained from the State Primary School Education Board. Letters were thereafter issued to officials of the Local Government Education Authority in the local government areas, and the head teachers of the selected primary schools for cooperation and assistance during the course of the research study. Parental consents were obtained through the school from Parents/Teachers Association, and the school children consents through interactive sessions facilitated by the head teacher of each school.

2.3. Sample population
A total population of 960 pupils which comprised children of four years of age and above (primary 1 to 5 pupils) in the three local government areas were used. Four schools were selected from each local government with a total population of 80 pupils sampled in each school to make a total of 320 pupils from each local government. The study was conducted between 2003 and 2005. The selected schools sampled in each local government are as follow:

- **Ewekoro Local Government:**
  - Baptist Central Primary School, Wasimi, Ogun State
  - All Saint Anglican Primary School, Itori, Ogun State
  - Saint Michael Anglican Primary School, Wasimi, Ogun State
  - Baptist Day Primary School, Egbesi, Ogun State

- **Ado-Odo-Ota Local Government:**
  - Saint Michael Anglican Primary School, Ota, Ogun State
  - Saint James Primary School, Ota, Ogun State
  - All Saint Anglican Primary School, Ado-Odo, Ogun State
  - Ansar Ur Deen Primary School Ado-Odo Ogun State

- **Ogun Water-Side Local Government:**
  - Saint Michael Anglican Primary School, Ibiade, Ogun State
  - Saint Thomas Anglican Primary School, Abigi, Ogun State
  - Muslim Primary School, Abigi, Ogun State
  - Local Government Primary School, Makun-Omi, Ogun State

2.4. Treatment and worm examination
A broad-spectrum Antihelminthic Levamex (containing 40 mg of Levamisole, manufactured by UNIBIOS Laboratories Ltd, India) was administered to all respondents in the study in accordance with manufacturer’s instructions (dosage based on age). The pupils were made to take the drug in our present and they were each given a labelled screw cap plastic container of about 1.5 L with an instruction to pass all stools for the next 24 to 48 h. The stools passed within 24 to 48 h of treatment were collected, preserved with 10% formalin and transported to the University of Agriculture, Abeokuta, Ogun State, Nigeria. Examination of worm was by flushing the stool with running water through sieve. The worms present were sorted into sexes, young and adult, and were counted and recorded. Before fixing the worms in 10% formalin, the length (cm) and weight (g)
were taken and characterized into young and adult worms using the measurement criteria of (Sam-Wobo et al., 2008).

2.5. Data analysis
Data recorded were analyzed using SPSS Version 16. The worms were classified into sexes, young and adult, and the measurement of length and weight of worms were taken. Analysis of variance (ANOVA) was used to compare the measurement by length and weight of female and male worms in all the three local government areas.

RESULTS
Morphometric studies of *Ascaris lumbricoides* expelled by the pupils showed that out of the 986 worms expelled, 613 (62.17%) were female worms, 373 (37.83%) were male worms (Table 1). Of the 613 female worms expelled, 60 (59.41%) were young and 553 (62.49%) were adult female worms, and of the 373 male worms expelled, 41 (40.59%) were young and 332 (37.51%) were adult male.

<table>
<thead>
<tr>
<th>Local government</th>
<th>Total worm</th>
<th>Young worm</th>
<th>Adults worm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Female (%)</td>
<td>Male (%)</td>
<td>Female (%)</td>
</tr>
<tr>
<td>Ewekoro</td>
<td>88 (57.89)</td>
<td>64 (42.11)</td>
<td>4 (44.40)</td>
</tr>
<tr>
<td>Ado-odo-Ota</td>
<td>35 (63.64)</td>
<td>20 (36.36)</td>
<td>21 (0.00)</td>
</tr>
<tr>
<td>Ogun-Waterside</td>
<td>490 (62.90)</td>
<td>289 (37.10)</td>
<td>54 (60.00)</td>
</tr>
<tr>
<td>Total</td>
<td>613 (62.17)</td>
<td>373 (37.83)</td>
<td>60 (59.41)</td>
</tr>
</tbody>
</table>

The weight and length profile of the worms are presented in Tables 2 and 3. An overall average maximum length (cm) and weight (g) of about 39.70 cm and 10.37 g, respectively were obtained from the length and weight measurement profile from the study with highest maximum length (cm) and weight (g) of about 46.00 cm and 13.60 g obtained in Ogun-Waterside, others are, 37.00 cm and 8.20 g in Ewekoro, and 36.00 cm and 9.30 g in Ado-odo-Ota. Also, an overall average minimum length (cm) and weight (g) of about 8.50 cm and 0.16 g, with lowest minimum length (cm) and weight (g) of about 4.00 cm and 0.01 g in Ogun-Waterside, others are 10.30 cm and 0.09 g in Ewekoro and 12.10 cm and 0.38 g in Ado-odo-Ota.

<table>
<thead>
<tr>
<th>Local government</th>
<th>Maximum length (cm)</th>
<th>Minimum length (cm)</th>
<th>Mean length measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Female</td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>Ewekoro</td>
<td>37.00</td>
<td>10.30</td>
<td>3.70 (4.48)</td>
</tr>
<tr>
<td>Ado-odo-Ota</td>
<td>36.00</td>
<td>12.10</td>
<td>1.30 (3.13)</td>
</tr>
<tr>
<td>Ogun-Waterside</td>
<td>46.00</td>
<td>4.00</td>
<td>20.20 (16.49)</td>
</tr>
<tr>
<td>Average Mean</td>
<td>39.70</td>
<td>8.80</td>
<td>8.4 (8.03)</td>
</tr>
</tbody>
</table>

The result shows an average total mean length measurement of 8.4 (8.03) ± 3.14 for female worms, 5.33 (7.30) ± 2.98 for male worms for the three local government areas. With respect to each local government, mean length of 3.70 (4.48) ± 1.62 (female) and 2.10 (4.04) ± 1.68 (male) in Ewekoro, 1.30 (3.13) ± 1.08 (female), 1.00 (2.77) ± 1.22 (male) in Ado-odo-Ota and 20.20 (16.49) ± 6.73 (female) and 12.40 (15.08) ± 6.15 (male) in Ogun-Waterside. Analysis of variance at P < 0.05 showed a significant difference in the measurement of length of both female and male worms across the three local government areas due to high rate of *Ascaris* infection (F = 9.52, P = 0.0002 (female worms) and F = 7.16, P = 0.0015 (male worms)).

<table>
<thead>
<tr>
<th>Local government</th>
<th>Maximum weight (g)</th>
<th>Minimum weight (g)</th>
<th>Mean weight measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Female</td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>Ewekoro</td>
<td>4.50 (6.34)</td>
<td>3.20 (6.35)</td>
<td>2.84 (6.34)</td>
</tr>
<tr>
<td>Ado-odo-Ota</td>
<td>1.00 (2.09)</td>
<td>3.20 (6.35)</td>
<td>1.49 (2.09)</td>
</tr>
<tr>
<td>Average Mean</td>
<td>10.13 (12.00)</td>
<td>6.38 (10.83)</td>
<td>5.52 (6.38)</td>
</tr>
</tbody>
</table>

Analysis of variance at P < 0.05 showed a significant difference in the measurement of length of both female and male worms across the three local government areas as a result of high rate of *Ascaris* infection (F = 9.52, P = 0.0002 (female worms) and F = 7.16, P = 0.0015 (male worms)). In Table 3, the values for total mean weight measurement of 10.13 (12.00) ± 5.52 for female worms and 6.38 (10.83) ± 4.56 for male worms across the three local governments are presented. The mean weight obtained in each local government are 4.50 (6.34) ± 2.84 for female worms and 3.20 (6.35) ± 2.84 for male worms in Ewekoro, 1.70 (2.71) ± 1.33 for female worms and 1.00 (2.09) ± 0.94 for male worms in Ado-odo-Ota and 14.94 (24.06) ± 10.79 for male worms and 24.20 (26.96) ± 12.39 for female worms in Ogun-Waterside. Analysis of variance (P < 0.05) showed a significant difference in the weight measurement of both female and male worms across the three local governments due to high rate of *Ascaris* infection (F = 5.03, P = 0.01 (female worms) and F = 3.79, P = 0.03 (male worms)).
y > 24.00 cm (female = 372 and male = 63) and 1.00 to 11.99 cm percentage of female adult worms than male worms as well as young female-juvenile worms, and male worms were significantly heavier and longer on their intellectual capability (worm population male worms observed from the study may also have resulted to high frequency distribution of the children can impair physical and mental growth, poor cognitive development as well as nutritional status the pupils' intestinal wall as reviewed by antihelminthic treatment of the pupils in the study areas. The result reveals highest percentage of female adult worms than male worms as well as young female and male worms, the high number of female adult worm observed across the three local governments’ inferred high rate of re-infection of Ascaris (Sam-Wobo and Mafiana, 2005). Sam-Wobo et al., (2008) observed in some studies that the high worm burden may not be related to the gender of the individual host, but their weight profile. Some worms recovered measured up to 46 cm and weighed up to 13.60 g with highest distribution of worm population observed within length range of 12.00 to 23.99 cm and weight range of 1.00 to 11.09 g which may be due to one or multiple of the following factors: lack of antihelminthic treatment or de-worming, low availability of sanitary facilities and health education, and development rate of embryonic stage in soil based on the supportive soil physio-chemical properties (Mafiana et al., 1998; Sam-Wobo and Mafiana, 2005; Sam-Wobo et al., 2008).

The frequency distribution revealed a heavier and longer range of female worms than male worms which showed that length and weight range of female worms were significantly heavier and longer than that of male worms and it is related to findings by Fatiregun and Oluwatoba, (2008). The bulky, heavier and longer worms obtained from the data inferred prevention of juvenile worms, absorption of intestinal wall (haemorrhage) by adult worms, re-infection rate and mal-absorption of nutrient (Sam-Wobo et al., 2005; Stephenson et al., 2000). This may result into an adverse effect on the pupils’ intestinal wall as reviewed by Edungbola and Obi, (1992) and Prosper et al., (2014), and can impair physical and mental growth, poor cognitive development as well as nutritional status of children (Hotez et al., 2008).

The length and weight profile, high percentage of female adult worms as well as young female and male worms observed from the study may also have resulted to high frequency distribution of the worm population as observed by Sam-Wobo et al., (2005); Sam-Wobo et al., (2007); Sam-Wobo et al., (2008); Sam-Wobo et al., (2012) and this has increase worm burden which may eventually has effect on their intellectual capability.

**Table 3: Mean values of weight (g) measurement of both female and male worms**

<table>
<thead>
<tr>
<th>Local government</th>
<th>Maximum weight (g)</th>
<th>Minimum weight (g)</th>
<th>Mean weight (g) measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Female</td>
<td>SEM</td>
<td>Male</td>
</tr>
<tr>
<td>Ewekoro</td>
<td>8.20</td>
<td>0.09</td>
<td>4.50 (6.34)</td>
</tr>
<tr>
<td>Ado-odo-Ota</td>
<td>9.30</td>
<td>0.38</td>
<td>1.30 (2.71)</td>
</tr>
<tr>
<td>Ogun-Waterside</td>
<td>13.60</td>
<td>0.01</td>
<td>24.20 (26.96)</td>
</tr>
<tr>
<td>Average Mean</td>
<td>10.37</td>
<td>0.16</td>
<td>10.13 (12.00)</td>
</tr>
</tbody>
</table>

SEM, Standard error of mean.

From the data obtained, the pattern of frequency distribution of length (cm) showed that a higher frequency was observed in length measurement (cm) class between 12.00 and 23.99 cm (female = 212 and male = 311) followed by > 24.00 cm (female = 372 and male = 63) and 1.00 to 11.99 cm (female 19 and male =12) as presented in Table 4. Also, pattern of frequency distribution of weight (cm) revealed a high frequency of weight (g) measurement class between 1.10 and 11.09 g (female = 524 and male = 302) followed by 0.01 and 1.09 g (female = 75, male = 81) and > 11.10 g (female = 6, male = 0).

**Table 4: Frequency distribution of length and weight class of both female and male worms**

<table>
<thead>
<tr>
<th>Local government</th>
<th>Worm length class (cm)</th>
<th>Worm weight class (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F M F M F M F M F M F M</td>
<td></td>
</tr>
<tr>
<td>Ewekoro</td>
<td>0 0 29 61 59 3 6 6 83 58 0 0</td>
<td></td>
</tr>
<tr>
<td>Ado-odo-Ota</td>
<td>0 0 7 21 24 3 1 4 32 16 0 0</td>
<td></td>
</tr>
<tr>
<td>Ogun-Waterside</td>
<td>19 12 176 229 289 57 68 71 409 228 6 0</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>19 12 212 311 372 62 75 81 524 302 6 0</td>
<td></td>
</tr>
</tbody>
</table>

**DISCUSSION**

Morphometric studies showed a high degree of heterogeneity in the body size of Ascaris within the population recovered following the antihelminthic treatment of the pupils in the study areas. The result reveals highest percentage of female adult worms than male worms as well as young female and male worms, the high number of female adult worm observed across the three local governments’ inferred high rate of re-infection of Ascaris (Sam-Wobo and Mafiana, 2005). Sam-Wobo et al., (2008) observed in some studies that the high worm burden may not be related to the gender of the individual host, but their weight profile.

The frequency distribution revealed a heavier and longer range of female worms than male worms which showed that length and weight range of female worms were significantly heavier and longer than that of male worms and it is related to findings by Fatiregun and Oluwatoba, (2008). The bulky, heavier and longer worms obtained from the data inferred prevention of juvenile worms, absorption of intestinal wall (haemorrhage) by adult worms, re-infection rate and mal-absorption of nutrient (Sam-Wobo et al., 2005; Stephenson et al., 2000). This may result into an adverse effect on the pupils’ intestinal wall as reviewed by Edungbola and Obi, (1992) and Prosper et al., (2014), and can impair physical and mental growth, poor cognitive development as well as nutritional status of children (Hotez et al., 2008).

The length and weight profile, high percentage of female adult worms as well as young female and male worms observed from the study may also have resulted to high frequency distribution of the worm population as observed by Sam-Wobo et al., (2005); Sam-Wobo et al., (2007); Sam-Wobo et al., (2008); Sam-Wobo et al., (2012) and this has increase worm burden which may eventually has effect on their intellectual capability.
In conclusion, the morphometric index could be useful in inferring the nutritional status, physiological and abdominal conditions of the children and could also lend support at interpreting the re-infection pattern of helminthes infection which plays key role in disease epidemiology.

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The authors appreciate the support of the head teachers, parents and pupils of the schools during the study.

REFERENCES


