INFECTION AND REINFECTION OF SOIL-TRANSMITTED HELMINTHS AMONG CHILDREN OF SEKOLAH KEBANGSAAN GENTISAN, SABAH

NORAZWANI BINTI NOOR

THIS THESIS IS SUBMITTED AS FULFILMENT OF THE REQUIREMENT FOR THE DEGREE OF SCIENCE

CONSERVATION BIOLOGY
SCHOOL OF SCIENCE AND TECHNOLOGY
UNIVERSITY MALAYSIA SABAH

PERPUSTAKAAN
UNIVERSITI MALAYSIA SABAH

March 2005
**BORANG PENGESAHAN STATUS TESIS**

**JUDUL:** INFECTION AND REINFECCTION OF SOIL-TRANSMITTED HELMINTHS AMONG CHILDREN OF SEKOLAH KEBANGSAAN GENTIAN SABAH

**Ijazah:** SARJANA MUDA SAINS (BIOLIGI PEMULIHARAN)

**SESU PENGAJIAN:** 2002/2005

Saya NORADAWANI BINTI NOOR

(HURUF BESAR)

mengaku membenarkan tesis (LPS/Sarjana/Doktor Falsafah)* ini disimpan di Perpustakaan Universiti Malaysia Sabah dengan syarat-syarat kegunaan seperti berikut:

1. Tesis adalah bakmulik Universiti Malaysia Sabah.
2. Perpustakaan Universiti Malaysia Sabah dibenarkan membuat salinan untuk tujuan pengajian sabaja.
3. Perpustakaan dibenarkan membuat salinan tesis ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. **Sila tandakan ( / )**

   - [ ] SULIT (Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia seperti yang termaktub di dalam AKTA RAHASIA RASMI 1972)
   - [ ] TERHAD (Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)
   - [ ] TIDAK TERHAD

**Disahkan oleh**

(TANDATANGAN PENULIS)

(TANDATANGAN PUSTAKAWAN)

Alamat Tetap: —

Nama Penyelesa

Tarikh: 34.2.2005

CATATAN:

* Potong yang tidak berkenaan.

- Jika tesis ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh tesis ini perlu diklasifikasikan sebagai SULIT dan TERHAD.
- Tesis dimaksudkan sebagai tesis bagi ijazah Doktor Falsafah dan Sarjana secara penyelidikan, atau disertasi bagi pengajian secara kerja kursus dan penyelidikan, atau Laporan Projek Sarjana Muda (LPSM).
DECLARATION

I hereby declare that the thesis is based on my original work except for the quotations and citations which I have duly acknowledged.

31 March 2005

[Signature]

NORAZWANI BINTI NOOR
HS2002-3580
CERTIFIED BY

1. SUPERVISOR
   (EN HAIRUL HAFIZ MAHSOL)

2. EXAMINER 1
   (PROF MADYA DR ABDUL HAMID AHMAD)

3. EXAMINER 2
   (PN ANNA WONG)

4. DEAN
   (PROF MADYA DR AMRAN AHMED)
ACKNOWLEDGEMENT

I endlessly recite my “Syukur” (thankful) to Allah S.W.T; The All Mighty, for His blessings.

In this very special page, I wish to extend my heartfelt gratitude to the numerous people who have helped me over the long haul.

Among the many people to whom I am indebted to, I must single out my beloved parents, Hj. Noor Laldin and Hjh. Zainab Ahmad. You are the backbone of my success.

I wish to convey my appreciation to my lecturers, thesis examiners and especially my outstanding thesis supervisor, En. Hairul Hafiz Mahsol for their professionalism, countless contributions, compulsive dedication and exceptional patience.

I am also very thankful to En. Abdul Malik, Pn. Hjh. Amnah, teachers and students of Sekolah Kebangsaan Gentisan, who had shown commitment to excellence.

Thank you for making this study a remarkable experience.
ABSTRACT

A parasitological study was undertaken at Sekolah Kebangsaan Gentisan, Sabah among 120 school children aged 7, 8 and 9 years old to determine the relation between the soil-transmitted helminths (STH) infection and sex, age and domicile. Stool samples were collected in plastic containers and examined using the direct faecal smear, brine gravity flotation and Harada Mori culture methods. Questionnaires were distributed in order to obtain personal details and information on the children's standard of living. Among all the children investigated, 41 (34.2%) children were infected with STH, of which 25.0% had single STH infection, double infection (7.5%) and triple infection (1.7%). The most common species found was *Ascaris lumbricoides* (75.6%), followed by hookworm (48.8%) and *Trichuris trichiura* (7.3%). Chi-square test showed a significant association between STH infection and age (P<0.05). There was no significant association between STH infection and sex as well as domicile (P>0.05). The infected children were given a single-dose 200mg albendazole for treatment purposes. After a three months interval, the second collection was made involving the same group of children. Only 57.5% children returned their stool samples. Examination proved the anthelminthic drug was 100% effective, hence there were no reinfection cases. Also, there was no incidence reported among the stools examined. The study demonstrated that the STH infection rate among the school children was affected by their age.
ABSTRAK

Kajian parasitologi telah dilaksanakan di kalangan 120 orang kanak-kanak dari Sekolah Kebangsaan Gentisan, Sabah, yang berumur 7, 8 dan 9 tahun untuk menentukan hubungan di antara infeksi cacing tularan tanah (CTT) dengan jantina, umur dan tempat tinggal. Sampel najis telah dikumpul ke dalam bekas plastik dan dikaji dengan menggunakan kaedah pengamatan langsung calitan najis, pengapungan larutan tepu dan teknik kultur Harada Mori. Borang soal selidik telah diedarkan untuk mendapatkan maklumat peribadi dan taraf hidup kanak-kanak. Bagi kesemua kanak-kanak yang telah dikaji, 41 (34.2%) orang telah dijangkiti oleh CTT, di mana 25.0% dijangkiti infeksi tunggal, infeksi campuran antara dua spesies (7.5%) dan infeksi campuran antara tiga spesies (1.7%). CTT yang paling kerap ditemui ialah *Ascaris lumbricoides* (75.6%), diikuti oleh cacing kait (48.8%) and *Trichuris trichiura* (7.3%). Ujian khi-kuasa dua telah menunjukkan bahawa ada hubungan yang signifikan di antara infeksi CTT dengan umur (P<0.05). Tiada hubungan yang bererti di antara infeksi CTT dengan jantina dan tempat tinggal (P>0.05). Satu dos 200mg albendazole telah diberikan kepada kanak-kanak yang dijangkiti CTT untuk tujuan rawatan. Selepas tiga bulan, pengumpulan najis kali kedua telah dilaksanakan dan melibatkan kumpulan kanak-kanak yang sama. Hanya 57.5% kanak-kanak telah memulangkan sampel najis. Kajian membuktikan bahawa ubat antihelmin yang diberikan adalah 100% berkesan, yakni tiada kes reinfeksi. Kes insiden juga langsung tidak ditemui di kalangan sampel yang dikaji. Kajian telah menunjukkan bahawa kadar infeksi CTT di kalangan kanak-kanak telah dipengaruhi oleh umur mereka.
CONTENTS

TITLE PAGE i
DECLARATION ii
APPROVAL OF EXAMINERS iii
ACKNOWLEDGEMENT iv
ABSTRACT v
ABSTRAK vi
CONTENTS vii
LIST OF TABLES x
LIST OF FIGURES xi
LIST OF SYMBOLS xii

CHAPTER 1 INTRODUCTION

1.1 Introduction 1
1.2 Study Justification 3
1.3 Objectives 4

CHAPTER 2 LITERATURE REVIEW

2.1 Introduction 6
2.2 Morphology of Common Soil-Transmitted Helminths 8
  2.2.1 Ascaris lumbricoides 9
  2.2.2 Trichuris trichiura 10
  2.2.3 Hookworm 10
CHAPTER 5 DISCUSSION

5.1 Introduction

5.2 STH Infection According to Sex

5.3 STH Infection According to Age

5.4 STH Infection According to Domicile

5.5 Incidence and STH Reinfection Status

5.6 Household Risks on STH Infection

5.7 Effects of STH Infection on Host

5.8 Effects of Human as Host and Vector for STH

5.9 Effects of Human on the Environment

CHAPTER 6 CONCLUSION

6.1 Conclusion

6.2 Suggestion

6.3 Conservation Aspects

REFERENCES

APPENDICES

Appendix A Questionnaire

Appendix B Identification code for students elected to the stool sample

Appendix C List of reagents and equipments used throughout the study

Appendix D Rate of single and multiple STH infection among the children of S. K. Gentisan, Sabah by sex, age and domicile

Appendix E Chi-Square tests outputs
<table>
<thead>
<tr>
<th>Table No.</th>
<th>Table Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>Classification based on musculature</td>
<td>7</td>
</tr>
<tr>
<td>2.2</td>
<td>Systematic classification of pathogenic Nematodes</td>
<td>8</td>
</tr>
<tr>
<td>2.3</td>
<td>General morphology of the common soil-transmitted helminth ova</td>
<td>16</td>
</tr>
<tr>
<td>2.4</td>
<td>Intensity of infection expressed in number of eggs per gram of stool</td>
<td>17</td>
</tr>
<tr>
<td>4.1</td>
<td>Single and multiple soil-transmitted helminth infections within 120 stool samples examined</td>
<td>26</td>
</tr>
<tr>
<td>4.2</td>
<td>2x2 Crosstabulation table: Relation between infection and sex</td>
<td>29</td>
</tr>
<tr>
<td>4.3</td>
<td>2x2 Crosstabulation table: Relation between infection and age</td>
<td>31</td>
</tr>
<tr>
<td>4.4</td>
<td>2x2 Crosstabulation table: Relation between infection and domicile</td>
<td>33</td>
</tr>
<tr>
<td>4.5</td>
<td>Recorded cases within the total samples in each collection</td>
<td>35</td>
</tr>
<tr>
<td>4.6</td>
<td>Number of family member per household within 120 stool samples</td>
<td>35</td>
</tr>
<tr>
<td>4.7</td>
<td>Reported symptoms within the number of children positive for STH</td>
<td>37</td>
</tr>
</tbody>
</table>
## LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure No.</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1</td>
<td>Location of Sekolah Kebangsaan Gentisan, Sabah</td>
<td>19</td>
</tr>
<tr>
<td>3.2</td>
<td>A satisfactory film for slide preparation</td>
<td>22</td>
</tr>
<tr>
<td>3.3</td>
<td>Systematic way of smear scanning</td>
<td>22</td>
</tr>
<tr>
<td>4.1</td>
<td>Infection according to STH species within 120 stool samples examined</td>
<td>27</td>
</tr>
<tr>
<td>4.2</td>
<td>Prevalence of STH infection according to category for 2 consecutive years</td>
<td>28</td>
</tr>
<tr>
<td>4.3</td>
<td>Relation between the counts of samples and sex</td>
<td>30</td>
</tr>
<tr>
<td>4.4</td>
<td>Relation between the counts of samples and age</td>
<td>32</td>
</tr>
<tr>
<td>4.5</td>
<td>Relation between the counts of samples and domicile</td>
<td>34</td>
</tr>
<tr>
<td>4.6</td>
<td>STH Infection according to family member per household within 120 stool samples examined</td>
<td>36</td>
</tr>
<tr>
<td>4.7</td>
<td>Symptoms encountered by infected children according to sex</td>
<td>38</td>
</tr>
</tbody>
</table>
## LIST OF SYMBOLS

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>km</td>
<td>kilometre</td>
</tr>
<tr>
<td>cm</td>
<td>centimetre</td>
</tr>
<tr>
<td>g</td>
<td>gram</td>
</tr>
<tr>
<td>mg</td>
<td>milligram</td>
</tr>
<tr>
<td>mm</td>
<td>millimetre</td>
</tr>
<tr>
<td>ml</td>
<td>millilitre</td>
</tr>
<tr>
<td>μm</td>
<td>micrometer</td>
</tr>
<tr>
<td>μl</td>
<td>microlitre</td>
</tr>
<tr>
<td>°C</td>
<td>degrees Celsius</td>
</tr>
<tr>
<td>®</td>
<td>registered</td>
</tr>
<tr>
<td>%</td>
<td>percent</td>
</tr>
<tr>
<td>&gt;</td>
<td>greater than</td>
</tr>
<tr>
<td>&lt;</td>
<td>less than</td>
</tr>
<tr>
<td>=</td>
<td>equals to</td>
</tr>
<tr>
<td>STH</td>
<td>soil-transmitted helminth</td>
</tr>
<tr>
<td>EPG</td>
<td>eggs per gram of stool</td>
</tr>
<tr>
<td>UMS</td>
<td>Universiti Malaysia Sabah</td>
</tr>
<tr>
<td>S.K.</td>
<td>Sekolah Kebangsaan</td>
</tr>
<tr>
<td>Kg.</td>
<td>Kampung</td>
</tr>
<tr>
<td>SPSS</td>
<td>Statistic Package for Social Science</td>
</tr>
<tr>
<td>P</td>
<td>significance value</td>
</tr>
<tr>
<td>$\chi^2$</td>
<td>chi-square value</td>
</tr>
<tr>
<td>df</td>
<td>degrees of freedom</td>
</tr>
</tbody>
</table>
CHAPTER 1

INTRODUCTION

1.1 Introduction

Parasites are organisms that live in or on another organism at the expense of that host and often compete for nutrition (Skye, 2003). A number of these parasitic animals live in human as the host. These parasites are known as helminths, or commonly called worms. The name helminth, was derived from the Greek words “helmins” or “helminthos” (Soulsby, 1968). According to Lambert (1969), helminths belong to the sub-kingdom Metazoa, denoting that they are multicellular, in which cells are differentiated into specialized organs. Most species belong to the phylum Platyhelminthes and Nematoda (Campbell et al., 2002; Tortora et al., 2002).

There are over 1000 species of parasites that could infect man, which include helminths and protozoan (Skye, 2003). The World Health Organization (WHO) estimated that more than 1 million of the world population had confronted with health complications due to soil-mediated helminthiases infestation (Albonico et al., 1993). According to the WHO Biregional Meeting on Prevention and Control of Selected
Parasitic Diseases in 1998, of all the cases reported, helminth infection was ranked third after diarrhoea and tuberculosis. The prevalence rate was high in almost every developing country and even higher in deprived countries (Salvioli et al., 1992). Helminth infections do not only occur throughout the tropics but also in countries of temperate zones, where it becomes the disease of highest importance (Nicoll, 1959). In some countries, it was reported that almost 100% of the inhabitants were infected with general intestinal helminth (Suzuki, 1975). In tropical and subtropical areas, the infection rate is soaring in rural areas with damp soil surroundings, such as near rice paddy fields and rubber plantations (Peters et al., 1989). According to various studies, high intensity of parasitic infection will have a significant impact on the health status (Salvioli et al., 1992; Albonico et al., 1993; Ferreira et al., 1998). Therefore, parasitic diseases have become a major health problem in the tropics due to the high prevalence and the outcome on both the nutritional and hygienic level in a community (Sinniah et al., 1988).

In Malaysia itself, soil-mediated helminthiasis are very common especially among children. The most common soil-transmitted helminths in Malaysia are Ascaris lumbricoides, Trichuris trichiura and the hookworm. The major species of hookworm are mainly Necator americanus and Ancylostoma duodenale (Lie, 1964; Sandosham et al., 1967; Kan, 1982; Sinniah et al., 1988; Cooper et al., 1992). According to a Helminthological survey of 1888 Malaysian school children carried out by Sinniah (1984), 52.7% of the children were infected with at least one of the common soil-transmitted helminth. The results were obtained by performing two concentration
techniques namely the Brine Flotation and the Katz Thick Smear, for quantitative and qualitative assessments.

The most preferred anthelminthic drug for use against *A. lumbricoides*, *T. trichiura* and hookworm is albendazole, although mebendazole and pyrantel pamoate are also known to be highly effective (Vines and Rees, 1972). A study on the effectiveness of a single-dose 400mg albendazole to treat *Ascaris*, *Trichuris* and hookworm infection in Orang Asli community found that the treatment with albendazole could have a significant impact on *Ascaris* and hookworm infection, but not on *Trichuris*. Despite the fact that the cure rate was low in *Trichuris* infection, the numbers of ova decreased and the reduction was more apparent compared to *Ascaris* and hookworm (Noorhayati *et al.*, 1997).

### 1.2 Study Justification

Since there have been no recent legitimate reports on parasitic studies conducted among school children in Sabah, this study may be useful in providing relevant data on the prevalence of helminth infection.

A parasitological study on the effects of soil-transmitted helminth infections on the academic performance among children of age 7, 9 and 11 was performed (Hairul, 2003). Three schools namely Sekolah Kebangsaan Likas, S.K Darau and S.K Gentisan in Kota Kinabalu were selected. Hairul (2003) stated that soil-transmitted helminth infection due to *A. lumbricoides*, *T. trichiura* and hookworm pose a major health problem among
school children in Malaysia. In another similar study performed in S.K Gentisan (Lee, 2004), the prevalence of soil-transmitted helminth (STH) among the school children were determined. Although the relation between the age and sex were evaluated in both studies, neither of them examined the relation between the infection rates and the children’s domicile. Furthermore, in the recent study on the STH prevalence, no detailed measures were performed in order to inspect the effects of the anthelminthic drug on the parasitic infections.

Therefore this study will provide more information on the infection of soil-transmitted helminth and will discuss more on the effects of these parasites on the host and environment.

1.3 Objectives

The aim of this study is to determine and compare the infection and reinfection rates of soil-transmitted helminth among the children of different sex, age and domicile. Subsequently, the objectives of this study are to determine the infection and reinfection rates of common soil-transmitted helminths of the species namely *Ascaris lumbricoides*, *Trichuris trichiura*, *Necator americanus* and *Ancylostoma duodenale*, as well as to compare the rates of single and multiple infections by the three factors namely sex, age and domicile. The domicile refers to the permanent residence of the children, which is either rural or urban.
The scope of this study is to examine the ova and larvae of common soil-transmitted helminth in the faeces of the children through the direct smear scanning, examination by a concentration technique and examination by a culture method.
CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Helminth was originally referred to intestinal worms but now includes free living as well as tissue worms (Ichhpujani et al., 1998; Campbell et al., 1999). The helminths are from the sub-kingdom Metazoa where it arise from more than one embryonic layer. The tissues are differentiated into alimentary, excretory, reproductive and nervous systems. The classes of Platyhelminthes are Turbellaria (flatworms), Monogenea (monogeneans), Trematoda (flukes) and Cestoidea (tapeworms) (Campbell et al., 1999). The Class Nematoda that used to be from the phylum Nemathelminthes (Soulsby, 1968), is now classified as the Phylum Nematoda (Campbell et al., 2002; Miller et al., 2002).

The classification of nematodes can be made based on several important criteria, which are habitat of worm in host, mode of infection, the production of ova and larvae, musculature and systematic (zoological) classification. The habitat of *Ascaris lumbricoides, Ancylostoma duodenale* and *Necator americanus* are in the host’s small
intestine, while *Trichuris trichiura* is found in the large bowel. According to the mode of infection, *A. lumbricoides* and *T. trichiura* will infect the host by ingestion of the embryonated ova that may be found in contaminated food or water (Arora et al., 2001). Whereas, the hookworms usually infect man via skin penetration in larva form known as the filariform larvae. *Ascaris, Trichuris* and hookworm are similar when classified based on the ova and larvae production as the females of all the species are oviparous (lay eggs). However, hookworm produce segmented ovum, but *A. lumbricoides* and *T. trichiura* produce unsegmented ovum (Arvind et al., 2002). The systematic classification and classification based on musculature (Ichhpujani et al., 1998; Arora et al., 2001) are simplified in the following tables (Table 2.1 and Table 2.2):

**Table 2.1 Classification based on musculature.**

<table>
<thead>
<tr>
<th>Species</th>
<th>Ascaris</th>
<th>Trichuris</th>
<th>hookworm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Polymyarian</td>
<td>Holomyarian</td>
<td>Meromyarian</td>
</tr>
<tr>
<td>Size of cells</td>
<td>Small, uniform</td>
<td>Small, uniform</td>
<td>Large, various</td>
</tr>
<tr>
<td>Lateral cords</td>
<td>Present</td>
<td>Absent</td>
<td>Present</td>
</tr>
<tr>
<td>Arrangement</td>
<td>Projecting into body cavity</td>
<td>Regular</td>
<td>Irregular</td>
</tr>
</tbody>
</table>
Table 2.2 Systematic classification of pathogenic nematodes.

<table>
<thead>
<tr>
<th>Genus</th>
<th>Order</th>
<th>Subclass</th>
<th>Superfamily</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Ascaris</em></td>
<td><em>Ascaridida</em></td>
<td><em>Secernentea</em> (formerly <em>Phasmidia</em>)</td>
<td><em>Ascaridoidea</em></td>
</tr>
<tr>
<td><em>Trichuris</em></td>
<td><em>Enoplida</em></td>
<td><em>Adenophorea</em> (formerly <em>Aphasmidia</em>)</td>
<td><em>Trichinelloidea</em></td>
</tr>
<tr>
<td>Hookworm</td>
<td><em>Strongylida</em></td>
<td><em>Secernentea</em> (formerly <em>Phasmidia</em>)</td>
<td><em>Ancylostomatoidea</em></td>
</tr>
</tbody>
</table>

2.2 Morphology of Common Soil-Transmitted Helminths

Although the nematodes differ in size and habitat, most of their structures are similar to one another. The nematodes have a long cylindrical, elongated and unsegmented body shape without appendages. Nematodes are bilaterally symmetrical without a distinct head and lack of locomotion organ (Miller et al., 2002). The movement is assisted by muscular contraction and relaxation of its body (Soulsby, 1968). They do not have a digestive system of their own or in other words, they only possess a very basic digestive system consist of the mouth part, esohagus, intestine, rectum and the anus (Ichhpujani et al., 1998). The exterior is covered with cuticle, a tough protein structure that provides circular annulations and confer a whitish or yellowish tint to its body, although some might appear absolutely transparent (Arvind et al., 2002). The cuticle is relatively thick in nematodes to provide resistance to the host’s digestive system. In Cestoids and Trematodes, it may form adhesive structures such as spines, hooks or a cephalic collar. Nematodes have well developed buccal capsule but the hook and sucker structures are absent. Nematodes have a very primitive nervous system comprise of nerve rings around
the mouth, esophagus, sensory papillae and on the cuticle. However, the reproductive system is very well developed. The female nematode is relatively larger than the male. The sexes may be either diecious or monoecious (hermaphrodite). All nematodes are diecious but most Cestoids and Trematodes are hermaphrodites (Soulsby, 1968; Wahab, 1993). Most nematodes are macroscopic in size, therefore are visible to the naked eye (Ichhpujani et al., 1998). The size varies from the largest, *Dracunculus medinensis* (Guineaworm) that may attain a length of a metre or more, to the smallest, *Trichinella spiralis* of only 1 to 4mm in length (Arvind et al., 2002).

### 2.2.1 *Ascaris lumbricoides*

Being of large size and found abundantly, *Ascaris* is much known as the large intestinal roundworm. The *Ascaris* adult have a large, broad, cylindrical body structure with tapering ends and slightly pinkish in colour. The size of a female is 20 to 35cm long and 4 to 6mm in width and the male is 15 to 31cm long and 2 to 4mm in width (Arvind et al., 2002). The size of its larvae is 70 x 40μm (Wahab, 1993). A vulvar waist is present on a female *Ascaris*. The vulvar waist is a constriction on the body where there is an opening between the anterior and the middle part of the body (Arora et al., 2001). Three finely toothed lips covered with sensory papillae are present at the triangular shaped mouthpart found at the anterior end (Arvind et al., 2002). The sexes are easily differentiated by comparing the posterior ends. The male bears spicules at the curved, hook-like posterior. But the female posterior is conical and straight, and the spicule is absent (Miller et al., 2002).
2.2.2 *Trichuris trichiura*

The common name for *Trichuris* is the whipworm. They are so-called because of its thread-thin and whip-like shaped body. The thread-like region occupies about two thirds of the body length (Arvind *et al*., 2002). *Trichuris* are smaller than *Ascaris*. The female measures 35 to 50mm long but the male is slightly slender and shorter, measuring 30 to 45mm. The larvae size is 50\(\mu\)m in size (Wahab, 1993). The anterior is narrow and usually buried in the intestinal mucous with the posterior hanging in the intestinal lumen (Ichhpujani *et al*., 1998). The posterior end of a male worm is firmly coiled with the presence of a single spicule. In contrast, the female posterior is slightly curved ventrally resembling a buggy whip, or at times, may be almost straight (Miller *et al*., 2002).

2.2.3 Hookworm

The major gastrointestinal hookworms that infect men are *Ancylostoma duodenale* and *Necator americanus*. The species *A. duodenale* is also known as the “Old World Hookworm” and *N. americanus* is known as the “New World Hookworm” (Campbell *et al*., 2002; Miller *et al*., 2002). *A. duodenale* is larger and more robust than *N. americanus*. A female *A. duodenale* is 10 to 13mm long while the male only measures up between 8 to 11 mm. The size of an adult *N. americanus* female is 10 to 12 mm long and the male is 5 to 9mm long (Arvind *et al*., 2002; Arora *et al*., 2001). The larvae size for *N. americanus* is slightly larger, which is 60 to 75\(\mu\)m compared to *A. duodenale* that is only 50 to 60\(\mu\)m. There are four hook-like and two knobby-like teeth present at the mouthpart of *A.*
duodenale. The *N. americanus* have two cutting plates at the ventral and the dorsal of the mouthpart respectively (Wahab, 1993; Arora *et al*., 2001)

### 2.3 Lifecycle of Common Soil-Transmitted Helminths

Soil-transmitted helminthic infections are of two types. The *Ascaris* and *Trichuris* that merely survive in damp soil as ova will infect man when ingested. Whereas, the hookworms will undergo a cycle development in the soil into an infective stage of larvae (Peters *et al*., 1989).

#### 2.3.1 *Ascaris lumbricoides*

*Ascaris* requires only one host to complete its life cycle. The females may lay as many as 200 000 ova per day. The eggs are passed in the faeces of the host and develop to the infective stage in at least 10 days, depending on the temperature (Arvind *et al*., 2002). The favourable condition for embryonation is high humidity with the temperature 22-30°C. The larvae moult once in the ova into the second stage larvae, which is the infective stage. The ingested ova will hatch in the intestine and the larvae will burrow into the gut through the walls (Soulsby, 1968). The larvae will migrate to the liver and carried by the blood stream through the heart towards the lungs (Arora *et al*., 2001). On the seventh or eighth day of infection, the larvae will migrate from the trachea to the pharynx when they are swallowed. By the time it arrives in the intestine, the larvae is in its third stage. The fourth stage larvae will moult in the respiratory system. By the fourteenth day after
REFERENCES


