ABOUT IJMMS

The International Journal of Medicine and Medical Sciences is published monthly (one volume per year) by Academic Journals.

The International Journal of Medicine and Medical Sciences (IJMMS) provides rapid publication (monthly) of articles in all areas of Medicine and Medical Sciences such as:

Clinical Medicine: Internal Medicine, Surgery, Clinical Cancer Research, Clinical Pharmacology, Dermatology, Gynaecology, Paediatrics, Neurology, Psychiatry, Otorhinolaryngology, Ophthalmology, Dentistry, Tropical Medicine, Biomedical Engineering, Clinical Cardiovascular Research, Clinical Endocrinology, Clinical Pathophysiology, Clinical Immunology and Immunopathology, Clinical Nutritional Research, Geriatrics and Sport Medicine

Basic Medical Sciences: Biochemistry, Molecular Biology, Cellular Biology, Cytology, Genetics, Embryology, Developmental Biology, Radiobiology, Experimental Microbiology, Biophysics, Structural Research, Neurophysiology and Brain Research, Cardiovascular Research, Endocrinology, Physiology, Medical Microbiology

Experimental Medicine: Experimental Cancer Research, Pathophysiology, Immunology, Immunopathology, Nutritional Research, Vitaminology and Ethiology

Preventive Medicine: Congenital Disorders, Mental Disorders, Psychosomatic Diseases, Addictive Diseases, Accidents, Cancer, Cardiovascular Diseases, Metabolic Disorders, Infectious Diseases, Diseases of Bones and Joints, Oral Preventive Medicine, Respiratory Diseases, Methods of Epidemiology and Other Preventive Medicine

Social Medicine: Group Medicine, Social Paediatrics, Medico-Social Problems of the Youth, Medico-Social Problems of the Elderly, Rehabilitation, Human Ecology, Environmental Toxicology, Dietetics, Occupational Medicine, Pharmacology, Ergonomy, Health Education, Public Health and Health Services and Medical Statistics

The Journal welcomes the submission of manuscripts that meet the general criteria of significance and scientific excellence. Papers will be published approximately one month after acceptance. All articles published in IJMMS are peer-reviewed.

Contact

Editorial Office: ijmms@academicjournals.org
Desk: helpdesk@academicjournals.org
Website: http://www.academicjournals.org/journal/IJMMS
Submit manuscript online http://ms.academicjournals.me/
Editors

Dr. J. Ibekwe
Acting Editor-in-chief,
International Journal of Medicine and Medical Sciences Academic Journals
E-mail: ijmms.journals@gmail.com
http://www.academicjournals.org/ijmms

Afrozul Haq
Editor, Laboratory Medicine
Department of Laboratory Medicine
Sheikh Khalifa Medical City
P.O. Box 51900, ABU DHABI
United Arab Emirates
Editorial Board

Chandrashekhar T. Sreeramareddy
Department of Community Medicine,
P O Box No 155, Deep Heights
Manipal College of Medical Sciences,
Pokhara,
Nepal

Sisira Hemananda Siribaddana
259, Temple Road, Thalapathpitiya,
Nugegoda, 10250
Sri Lanka

Dr. santi M. Mandal
Internal Medicine
UTMB, Galveston, TX,
USA

Konstantinos Tziomalos
Department of Clinical Biochemistry
(Vascular Prevention Clinic),
Royal Free Hospital Campus,
University College Medical School, University College
London, London,
United Kingdom

Cyril Chukwudi Dim
Department of Obstetrics & Gynaecology
University of Nigeria Teaching Hospital (UNTH)
P. M. B. 01129, Enugu. 400001,
Nigeria

Mojtaba Salouti
School of Medical and Basic Sciences,
Islamic Azad University- Zanjan,
Iran

Imtiaz Ahmed Wani
Srinagar Kashmir, 190009,
India

Professor Viroj Wiwanitkit
Wiwanitkit House, Bangkhae,
Bangkok
Thailand 10160

Dr. Srinivas Koduru
Dept of Clinical Sciences
College of Health Sciences
University of Kentucky
Lexington USA

Weiping Zhang
Department of Oral Biology
Indiana University School of Dentistry
1121 West Michigan Street, DS 271
Indianapolis, IN 46202
USA

Lisheng Xu
Ho Sin Hang Engineering Building
Department of Electronic Engineering
The Chinese University of Hong Kong
Shatin, N. T. Hong Kong,
China

Dr. Mustafa Sahin
Department of Endocrinology and Metabolism
Baskent University,
Ankara,
Turkey

Dr. Harshdeep Joshi
Maharishi Markandeshwar
Institute of Medical Sciences and Research
Ambala, (Haryana),
India.
Instructions for Author

Electronic submission of manuscripts is strongly encouraged, provided that the text, tables, and figures are included in a single Microsoft Word file (preferably in Arial font).

The cover letter should include the corresponding author’s full address and telephone/fax numbers and should be in an e-mail message sent to the Editor, with the file, whose name should begin with the first author’s surname, as an attachment.

Article Types
Three types of manuscripts may be submitted:

Regular articles: These should describe new and carefully confirmed findings, and experimental procedures should be given in sufficient detail for others to verify the work. The length of a full paper should be the minimum required to describe and interpret the work clearly.

Short Communications: A Short Communication is suitable for recording the results of complete small investigations or giving details of new models or hypotheses, innovative methods, techniques or apparatus. The style of main sections need not conform to that of full-length papers. Short communications are 2 to 4 printed pages (about 6 to 12 manuscript pages) in length.

Reviews: Submissions of reviews and perspectives covering topics of current interest are welcome and encouraged. Reviews should be concise and no longer than 4-6 printed pages (about 12 to 18 manuscript pages). Reviews are also peer-reviewed.

Review Process
All manuscripts are reviewed by an editor and members of the Editorial Board or qualified outside reviewers. Authors cannot nominate reviewers. Only reviewers randomly selected from our database with specialization in the subject area will be contacted to evaluate the manuscripts. The process will be blind review.

Decisions will be made as rapidly as possible, and the journal strives to return reviewers’ comments to authors as fast as possible. The editorial board will re-review manuscripts that are accepted pending revision. It is the goal of the UMMS to publish manuscripts within weeks after submission.

Regular articles
All portions of the manuscript must be typed double-spaced and all pages numbered starting from the title page.

The Title should be a brief phrase describing the contents of the paper. The Title Page should include the authors’ full names and affiliations, the name of the corresponding author along with phone, fax and E-mail information. Present addresses of authors should appear as a footnote.

The Abstract should be informative and completely self-explanatory, briefly present the topic, state the scope of the experiments, indicate significant data, and point out major findings and conclusions. The Abstract should be 100 to 200 words in length. Complete sentences, active verbs, and the third person should be used, and the abstract should be written in the past tense. Standard nomenclature should be used and abbreviations should be avoided. No literature should be cited.

Following the abstract, about 3 to 10 key words that will provide indexing references should be listed.

A list of non-standard Abbreviations should be added. In general, non-standard abbreviations should be used only when the full term is very long and used often. Each abbreviation should be spelled out and introduced in parentheses the first time it is used in the text. Only recommended SI units should be used. Authors should use the solidus presentation (mg/ml). Standard abbreviations (such as ATP and DNA) need not be defined.

The Introduction should provide a clear statement of the problem, the relevant literature on the subject, and the proposed approach or solution. It should be understandable to colleagues from a broad range of scientific disciplines.

Materials and methods should be complete enough to allow experiments to be reproduced. However, only truly new procedures should be described in detail; previously published procedures should be cited, and important modifications of published procedures should be mentioned briefly. Capitalize trade names and include the manufacturer’s name and address. Subheadings should be used. Methods in general use need not be described in detail.
**Results** should be presented with clarity and precision. The results should be written in the past tense when describing findings in the authors’ experiments. Previously published findings should be written in the present tense. Results should be explained, but largely without referring to the literature. Discussion, speculation and detailed interpretation of data should not be included in the Results but should be put into the Discussion section.

The **Discussion** should interpret the findings in view of the results obtained in this and in past studies on this topic. State the conclusions in a few sentences at the end of the paper. The Results and Discussion sections can include subheadings, and when appropriate, both sections can be combined.

The **Acknowledgments** of people, grants, funds, etc should be brief.

**Tables** should be kept to a minimum and be designed to be as simple as possible. Tables are to be typed double-spaced throughout, including headings and footnotes. Each table should be on a separate page, numbered consecutively in Arabic numerals and supplied with a heading and a legend. Tables should be self-explanatory without reference to the text. The details of the methods used in the experiments should preferably be described in the legend instead of in the text. The same data should not be presented in both table and graph form or repeated in the text.

**Figure legends** should be typed in numerical order on a separate sheet. Graphics should be prepared using applications capable of generating high resolution GIF, TIFF, JPEG or Powerpoint before pasting in the Microsoft Word manuscript file. Tables should be prepared in Microsoft Word. Use Arabic numerals to designate figures and upper case letters for their parts (Figure 1). Begin each legend with a title and include sufficient description so that the figure is understandable without reading the text of the manuscript. Information given in legends should not be repeated in the text.

**References**: In the text, a reference identified by means of an author’s name should be followed by the date of the reference in parentheses. When there are more than two authors, only the first author’s name should be mentioned, followed by ‘et al.’. In the event that an author cited has had two or more works published during the same year, the reference, both in the text and in the reference list, should be identified by a lower case letter like ‘a’ and ‘b’ after the date to distinguish the works.

**Examples**:

Nishimura (2000), Agindotan et al. (2003), (Kelebeni, 1983), (Usman and Smith, 2001), (Chege, 1998; Stein, 1987a,b; Tijani, 1993,1995), (Kumasi et al., 2001) References should be listed at the end of the paper in alphabetical order. Articles in preparation or articles submitted for publication, unpublished observations, personal communications, etc. should not be included in the reference list but should only be mentioned in the article text (e.g., A. Kingori, University of Nairobi, Kenya, personal communication). Journal names are abbreviated according to Chemical Abstracts. Authors are fully responsible for the accuracy of the references.

**Examples**:


**Case Studies**

Case Studies include original case reports that will deepen the understanding of general medical knowledge.

The **Title** should be a brief phrase describing the contents of the paper. The Title Page should include the authors’ full names and affiliations, the name of the corresponding author along with phone, fax and E-mail information. Present addresses of authors should appear as a footnote.

The **Abstract** should be informative and completely self-explanatory, briefly present the topic, state the scope of the experiments, indicate significant data, and point out major findings and conclusions. The Abstract should be 100 to 200 words in length. Complete sentences, active verbs, and the third person should be used, and the abstract should be written in the past tense. Standard nomenclature should be used and abbreviations should be avoided. No literature should be cited.

Following the abstract, about 3 to 10 **key words** that will provide indexing references should be listed.

A list of non-standard **Abbreviations** should be added. In general, non-standard abbreviations should be used only when the full term is very long and used often. Each abbreviation should be spelled out and introduced in parentheses the first time it is used in the text. Only recommended SI units should be used. Authors should use the solidus presentation (mg/ml).

The **Introduction** should provide a clear statement of the problem, the relevant literature on the subject, and the proposed approach or solution. It should be understandable to colleagues from a broad range of scientific disciplines.

The presentation of the case study should include the important information regarding the case. This must include the medical history, demographics, symptoms, tests etc. Kindly note that all information that will lead to the identification of the particular patient(s) must be excluded.

The conclusion should highlight the contribution of the study and its relevance in general medical knowledge.

The **Acknowledgments** of people, grants, funds etc. should be brief.

**References**: Same as in regular articles

**Short Communications**

Short Communications are limited to a maximum of two figures and one table. They should present a complete study that is more limited in scope than is found in full-length papers. The items of manuscript preparation listed above apply to Short Communications with the following differences: (1) Abstracts are limited to 100 words; (2) instead of a separate Materials and Methods section, experimental procedures may be incorporated into Figure Legends and Table footnotes; (3) Results and Discussion should be combined into a single section.

**Proofs and Reprints**: Electronic proofs will be sent (e-mail attachment) to the corresponding author as a PDF file. Page proofs are considered to be the final version of the manuscript. With the exception of typographical or minor clerical errors, no changes will be made in the manuscript at the proof stage. Because IJMMS will be published freely online to attract a wide audience, authors will have free electronic access to the full text (in both HTML and PDF) of the article. Authors can freely download the PDF file from which they can print unlimited copies of their articles.

**Copyright**: Submission of a manuscript implies: that the work described has not been published before (except in the form of an abstract or as part of a published lecture, or thesis) that it is not under consideration for publication elsewhere; that if and when the Manuscript is accepted for publication, the authors agree to automatic transfer of the copyright to the publisher.
Prevalence of *Hymenolepis nana* among primary school children in Burkina Faso

Mohamed Bagayan, Dramane Zongo, Adama Ouéda, Boubacar Savadogo, Hermann Sorgho, François Drabo, Amado Ouédraogo, Issouf Bamba, Yaobi Zhang, Gustave Boureima Kabré and Jean Noël Poda
Full Length Research Paper

Prevalence of *Hymenolepis nana* among primary school children in Burkina Faso

Mohamed Bagayan1,2*, Dramane Zongo2, Adama Ouéda1, Boubacar Savadogo2, Hermann Sorgho2, François Drabo3, Amado Ouédraogo3, Issouf Bamba4, Yaobi Zhang5, Gustave Boureima Kabré1 and Jean Noël Poda2

1Laboratory of Animals Biology and Ecology (Burkina Faso), University of Ouagadougou, Burkina Faso.
2National Center for Research in Science and Technology, Institute of Research in Health Sciences, Burkina Faso.
3Ministry of Health/Directorate of Fight Against Disease, National Program to Fight Against Neglected Tropical Diseases (PNLMTN), Burkina Faso.
4Helen Keller International, Regional Office for Africa, Ouagadougou, Burkina Faso.
5Helen Keller International, Regional Office for Africa, Dakar, Senegal.

Received 22 July 2015; Accepted 3 September, 2015

This cross-sectional descriptive study estimated the prevalence of *Hymenolepis nana* infection in primary school children living in Burkina Faso. A parasitological survey was conducted in 2013 in 22 primary schools located in eleven regions of Burkina Faso. Kato-Katz method was used as a technique to detect the *H. nana* eggs. The prevalence and intensity of the infection were determined by estimating the means of *H. nana* eggs per gram of faeces (epg). 3514 school children from 7 to 11 years old have been investigated. The overall prevalence of *H. nana* was 3.22%. It varied from 0 to 11.25% among the primary schools (p<0.001). The difference was not significant according to gender (p=0.963) and the children aged 8 and 9 years were more infected (p=0.021). The highest mean intensity of eggs was 162 epg according the primary schools. The distribution of *H. nana* in Burkina Faso was determined. The prevalence of *H. nana* was low in the different primary schools.

**Key words:** Prevalence, *Hymenolepis nana*, school children, Burkina Faso.

INTRODUCTION

*Hymenolepis nana* is the most prevalent parasite tapeworms (Magalhaes et al., 2013). It is a cosmopolitan parasite by its distribution and it is more prevalent in warm climates (Malheiros et al., 2014). It is endemic in Asia, Africa, Eastern and Southern Europe and Brazil (Huda Thaher, 2012; Malheiros et al., 2014). Infections due to *H. nana* are often asymptomatic when the level of infection is low (Mirdha and Samantray, 2002; Huda Thaher, 2012). But when the level of infection is heavy and chronic, these infections can cause diarrhoea, abdominal pain, headaches and dizziness (Mirdha and Samantray, 2002; Huda Thaher, 2012). Infections due to *H. nana* are associated with low absorption of vitamin B12 in the intestines (Mohammad and Hegazi, 2007).
Majority of the infections by *H. nana* is by self-infection through contaminated food or water with the eggs contained in faeces. The parasitic diagnosis is based on the detection of *H. nana* eggs in the faeces. There are many stool examination methods (Becker et al., 2011). The formalin-ether-concentration technique (FECT), Merthiolate-Iodure-Formol technique (MIF), Kato-Katz technique, direct analysis, Willis and Ritchie methods, etc., are the techniques for the diagnosis of *H. nana* infection. Among these methods, Kato-Katz technique is the most adapted for the research of helminths eggs (Kremer and Molet, 1975). Moreover, this technique can easily be carried out, and it is advisable for the survey (Montresor et al., 2004). *H. nana* is one of the causal agent of diarrhoea in Burkina Faso (Poda, 2007). It was detected several times in the hospitals (Ouermi et al., 2012; Cissé et al., 2011), and during the studies (Dianou et al., 2004; Poda et al., 2006; Zida et al., 2014; Sangaré et al., 2015). Therefore, the children of school age and adolescents in developing countries are the most exposed. *H. nana* is the most common tapeworm in the world and despite the consequences on the health of schoolchildren it has less attention (Magalhaes Soares et al., 2013). Unlike soil-transmitted helminths and schistosomiasis, there is no specific program against human hymenolepiasis. Burkina Faso started the fight against soil-transmitted helminths and schistosomiasis by treatment with praziquantel and albendazole. These medicines are not completely efficacious against *H. nana* with one dose (King, 2010). To fight against this parasite, it is necessary to do a mapping of the distribution of *H. nana*. This study proposes to initiate this approach in eleven of the thirteen regions that make up the Burkina Faso. This study aims to determine the prevalence of *H. nana* in primary schools in 13 regions of Burkina Faso.

**MATERIALS AND METHODS**

**Study sites**

The study was conducted in 22 primary schools located in eleven regions (Figure 1). These sites are the sentinel sites for schistosomiasis and soil-transmitted helminthiasis of the national program of fight against neglected tropical diseases (PNLMTN). These sites were purposefully selected by PNLMTN to monitor the program impact on schistosomiasis.

**Study population**

The random sampling method was used to select participants in the study after explanation of the aims of the study with school children and their parents. The study population consisted of students from 22 selected schools in 22 villages. The age of the participants ranged from 7 to 11 years in both sexes. In each school, students were selected from the first year to the fourth year of the primary school. In each class, 32 students consisting of 16 girls and 16 boys were selected. Each child received a stool container to collect a stool sample. The stool samples were collected from 8 to 9 am. The samples were brought to laboratory in the cool box. The analysis of stool began 1 h after the collection at 10 am.

**Parasitological analysis**

The Kato-Katz method (Katz et al., 1972) was used for the detection of *H. nana* eggs in the feces. The stool samples were filtered through a filter and the filtered stool samples were applied to glass slides with spatula and Kato-Katz templates (41.7 mg). The sample on the slide was covered with a cellophane membrane previously impregnated in a malachite green solution for 24 h. Reading was taken using an optical microscope. The number of eggs counted per slide was multiplied by 24 for the intensity of infection in the number of eggs/gram of feces (epg).

**Statistical analysis**

Data were analyzed by SPSS 20.0 software. The prevalence and confidence intervals (95% CI) were determined. Chi square test was used to compare the prevalence and p<0.05 was considered significant. Mann Whitney test was used to determine the distribution of *H. nana* eggs by sex. This test was used because there were only two variables. Kruskal-Wallis test was used to determine the distribution of the eggs of *H. nana* by region, age and the study sites. The arithmetic mean intensity of infections with standard errors (SE) were determined by taking into account all the participants. A geographical information system (GIS) software Quantum GIS-Valmiera (QGIS 2.2.0 – Valmiera) was used to plot the point prevalence of the infections for each primary school surveyed.

**RESULTS**

Three thousand five hundred and fourteen students participated in this study. The average age of participants was 9 ± 0.24 years. The overall prevalence of *H. nana* was 3.22% (95% CI: 2.69 - 3.86%). The arithmetic mean intensity of the infection was 38.16 ± 8.96 epg. The highest intensity of the infection was found among students in the Sahel region (128 ± 31.34 epg), North (91.58 ± 78.86 epg) and Centre North (59.70 ± 33.50 epg).

**Prevalence and intensity of infection according to the schools**

According to the schools surveyed, the prevalence varied from 0 to 11.25% (Table 1 and Figure 1). There are four sites where *H. nana* was not found. The highest prevalence was found at Windou Primary School. The difference in prevalence among schools was statistically significant (p<0.001). The Kruskal-Wallis test showed that the distribution of *H. nana* eggs was not uniform (h<0.001).

**Prevalence and intensity of infection according to the region and gender**

The prevalence ranged from 0 to 9.38% by region. The highest prevalence was encountered in the Sahel region. The comparison of prevalence showed that the difference was significant between regions (p<0.001) but not by gender (p = 0.963). The Mann-Whitney test showed that the distribution of *H. nana* eggs was uniform by gender (h = 0.963). The Kruskal-Wallis test showed that the distribution of *H. nana* eggs was not uniform according to region (h<0.001). The distribution of prevalence and mean *H. nana* intensity by gender and by region is shown in Table 2.

**Prevalence and intensity of infection according to age**

The difference of prevalence by age was significant (p = 0.021) and...
the highest prevalence was among the school children of 7 years old. The Kruskal-Wallis test showed that the distribution of H. nana eggs was not uniform according to age ($h = 0.02$). The distribution of prevalence and mean intensity of H. nana infection is shown in Table 3.

**DISCUSSION**

Poverty is a factor which contributes significantly to the public health problems. In developing countries, there are diseases that are directly related to the lack of properties and hygienic practice. Among the diseases we can cite human hymenolepiasis. Indeed, the prevalence of H. nana can be considered an indicator of fecal contamination of environment and hygienic practice in a society (Magalhaes Soares et al., 2013). In our study, the prevalence of H. nana infection was 3.22%. But in previous studies conducted in Burkina Faso, the prevalence of H. nana was 3.99 to 12.2% (Dianou et al., 2004; Poda et al., 2006; Ouermi et al., 2012). These prevalence rates could be explained by many factors that facilitate transmission of H. nana in regions of developing countries such as Burkina Faso. Transmission of H. nana is facilitated by the consumption of food contaminated by feces containing H. nana eggs. Kpoda et al. (2015) found in Burkina Faso the eggs of H. nana in water used for irrigation. The absence of a fountain, the lack of hygiene, and the presence of people already infected with H. nana in the concession are factors that contribute to the maintenance of transmission (Mason, 1994; Al-Shammari et al., 2001; Huda Thaher, 2012; Magalhaes Soares et al., 2013; Malheiros et al., 2014). At home overcrowding in concessions is a factor that would increase the risk of contamination of H. nana eggs (Magalhaes Soares et al., 2013). Infection of H. nana is asymptomatic and according to Mirdha and Samantray (2002), the presence of an infected person in a crowded concession is a contributing factor to its expansion. Contamination may also be in primary schools. In Burkina Faso, there are small markets in primary schools where students buy food. The hygienic conditions are not met in these small businesses (sales places, lack of water for washing hands, absence of hygiene of the sellers). These businesses contribute to maintaining transmission of H.
Table 1. Prevalence and intensity of *H. nana* infection according to the sites (primary schools).

<table>
<thead>
<tr>
<th>Primary school</th>
<th>No. of children examined</th>
<th>Prevalence (%) (95% CI)</th>
<th>Mean of eggs±SE (epg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tikan</td>
<td>160</td>
<td>6.25 (3.43 – 11.12)</td>
<td>45.45±22.82</td>
</tr>
<tr>
<td>Tiao</td>
<td>160</td>
<td>0.63 (0.11 – 3.46)</td>
<td>0.75±0.75</td>
</tr>
<tr>
<td>Nianlé</td>
<td>160</td>
<td>0 (0 – 2.34)</td>
<td>0</td>
</tr>
<tr>
<td>Lioulgou</td>
<td>160</td>
<td>1.88 (0.64 – 5.34)</td>
<td>1.35±0.80</td>
</tr>
<tr>
<td>Sidogo</td>
<td>160</td>
<td>6.25 (3.43 – 11.12)</td>
<td>26.70±10.89</td>
</tr>
<tr>
<td>Tougouri</td>
<td>160</td>
<td>3.75 (1.73 – 7.94)</td>
<td>92.70±66.12</td>
</tr>
<tr>
<td>Soala</td>
<td>160</td>
<td>3.75 (1.73 – 7.94)</td>
<td>42.56±23.05</td>
</tr>
<tr>
<td>Badongo</td>
<td>160</td>
<td>0.63 (0.11 – 3.46)</td>
<td>0.90±0.90</td>
</tr>
<tr>
<td>Mediga</td>
<td>160</td>
<td>1.88 (0.64 – 5.34)</td>
<td>16.03±15.43</td>
</tr>
<tr>
<td>Sampieri</td>
<td>154</td>
<td>1.25 (0.34 – 4.44)</td>
<td>1.09±0.78</td>
</tr>
<tr>
<td>Douré</td>
<td>160</td>
<td>5.63 (2.99 – 10.35)</td>
<td>172.5±157.60</td>
</tr>
<tr>
<td>Koumbri</td>
<td>160</td>
<td>5 (2.56 – 9.56)</td>
<td>10.65±5.52</td>
</tr>
<tr>
<td>Kari</td>
<td>160</td>
<td>3.75 (1.73 – 7.94)</td>
<td>60.30±31.20</td>
</tr>
<tr>
<td>Panamasso</td>
<td>160</td>
<td>1.88 (0.64 – 5.34)</td>
<td>50.10±48.16</td>
</tr>
<tr>
<td>Noumousso</td>
<td>160</td>
<td>0 (0 – 2.34)</td>
<td>0</td>
</tr>
<tr>
<td>Windou</td>
<td>160</td>
<td>11.25 (7.24 – 17.08)</td>
<td>169.52±50.76</td>
</tr>
<tr>
<td>Dori B</td>
<td>160</td>
<td>7.5 (4.34 – -</td>
<td>87.00±36.64</td>
</tr>
<tr>
<td>Gora</td>
<td>160</td>
<td>0 (0 – 2.34)</td>
<td>0</td>
</tr>
<tr>
<td>Nagbingou</td>
<td>160</td>
<td>2.5 (0.98 – 6.25)</td>
<td>1.18±0.68</td>
</tr>
<tr>
<td>Bayandi Palogo</td>
<td>160</td>
<td>2.5 (0.98 – 6.25)</td>
<td>23.40±13.04</td>
</tr>
<tr>
<td>Bawan</td>
<td>160</td>
<td>4.38 (2.14 – 8.76)</td>
<td>36.00±23.43</td>
</tr>
<tr>
<td>Douna</td>
<td>160</td>
<td>0 (0 – 2.34)</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 2. Prevalence and mean intensity of infection of *H. nana* according to region and gender.

<table>
<thead>
<tr>
<th>By region</th>
<th>No. of children examined</th>
<th>Prevalence of <em>H. nana</em> (%) (95% CI)</th>
<th>Mean of eggs±SE (epg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boucle du Mouhoun</td>
<td>320</td>
<td>3.44 (1.93 – 6.05)</td>
<td>23.10±11.47</td>
</tr>
<tr>
<td>Centre Est</td>
<td>320</td>
<td>0.94 (0.32 – 2.72)</td>
<td>0.68±0.40</td>
</tr>
<tr>
<td>Centre Nord</td>
<td>320</td>
<td>5 (3.10 – 7.97)</td>
<td>59.70±33.50</td>
</tr>
<tr>
<td>Centre Ouest</td>
<td>320</td>
<td>3.13 (1.71 – 5.66)</td>
<td>32.98±13.32</td>
</tr>
<tr>
<td>Centre Sud</td>
<td>320</td>
<td>1.25 (0.49 – 3.17)</td>
<td>8.47±7.73</td>
</tr>
<tr>
<td>Est</td>
<td>314</td>
<td>1.91 (0.88 – 4.1)</td>
<td>1.13±0.51</td>
</tr>
<tr>
<td>Nord</td>
<td>320</td>
<td>5.31 (3.34 – 8.34)</td>
<td>91.58±78.86</td>
</tr>
<tr>
<td>Hauts Bassins</td>
<td>480</td>
<td>1.88 (0.99 – 3.53)</td>
<td>36.80±19.12</td>
</tr>
<tr>
<td>Sud-Ouest</td>
<td>320</td>
<td>2.19 (1.07 – 4.45)</td>
<td>18±11.74</td>
</tr>
<tr>
<td>Cascades</td>
<td>320</td>
<td>0 (0 – 2.34)</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>By gender</th>
<th>No. of children examined</th>
<th>Prevalence of <em>H. nana</em> (%) (95% CI)</th>
<th>Mean of eggs±SE (epg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>1751</td>
<td>3.2 (2.74 – 4.13)</td>
<td>25.62±7.08</td>
</tr>
<tr>
<td>Female</td>
<td>1763</td>
<td>3.23 (0.25 – 4.16)</td>
<td>50.59±16.40</td>
</tr>
</tbody>
</table>

Table 3. Prevalence and intensity of *H. nana* infection according to age.

<table>
<thead>
<tr>
<th>Age</th>
<th>No. of children examined</th>
<th>Prevalence of <em>H. nana</em> (%) (95% CI)</th>
<th>Mean of eggs±SE (epg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>704</td>
<td>4.83 (3.48 – 6.67)</td>
<td>52.02±15.66</td>
</tr>
<tr>
<td>8</td>
<td>698</td>
<td>3.87 (2.67 – 5.57)</td>
<td>40.52±15.79</td>
</tr>
<tr>
<td>9</td>
<td>704</td>
<td>2.56 (1.63 – 4.01)</td>
<td>54.51±37.02</td>
</tr>
<tr>
<td>10</td>
<td>704</td>
<td>2.84 (1.85 – 4.35)</td>
<td>38.48±11.61</td>
</tr>
<tr>
<td>11</td>
<td>704</td>
<td>1.99 (1.19 – 3.31)</td>
<td>5.28±2.03</td>
</tr>
</tbody>
</table>
nana (Zongo et al., 2006). Indeed, a study in Iran showed that people who ate at the restaurants were the most exposed to intestinal parasites including *H. nana* (Sharif, 2015). In addition, children playing areas are not protected and often encounter animal and/or human feces. In four sites, the prevalence was zero. This absence of *H. nana* may be due to the method used for this study. Because the Kato-Katz technique is not sensitive when the intensity of infection is low (Knopp et al., 2009; Becker et al., 2011). In our study, the prevalence obtained was low as compared to those obtained in Mexico (Martinez-Barbabosa et al., 2010), in Tajikistan (Matthys et al., 2011), in the East and Northeast of Ethiopia (Tadesse, 2005; Gelaw et al., 2013). The low prevalence may also be explained by the construction of latrines in schools and rural areas in Burkina Faso, the education of hygiene, the use of chemical fertilizers instead of stools in the fields and the countrywide deworming in schools by the various mass treatment programs. Studies have shown that praziquantel could be effective against infections caused by *H. nana* (Rim et al., 1978; Farid et al., 1984). But the praziquantel treatment alone may not be enough, niclosamide should be used together to eradicate *H. nana* in an infected person (King, 2010). When comparing the prevalence by age, it was noticed that the difference was significant (p = 0.021), but children of 7 and 8 years old are the most infected. This result could be explained by the fact that at this age, children are not abiding by the hygiene rules and generally they do not wash their hands after using the toilet (Huda Thaher, 2012). Similar studies have shown that children were the most infected (Martinez-Barbabosa et al., 2010; Magalhaes Soares et al., 2013; Malheiros et al., 2014).

**Conclusion**

This study presented the distribution of *H. nana* among primary schools in Burkina Faso. It helped to know the current situation of *H. nana* infection among students. But it should continue to include other socio-economic factors and extend the investigations to other community members. For now, awareness campaign should be made to school children. The fight against this parasite could be integrated into the control program against neglected tropical diseases.

**Conflict of Interests**

The authors have not declared any conflict of interests.

**ACKNOWLEDGEMENTS**

Authors thank all school children and the teachers of the different primary schools. They also thank the National Program of Neglected Tropical Diseases, Ministry of Health of Burkina Faso for the support. This study was made possible with funding from the United States Agency for International Development (USAID) through a grant to Helen Keller International under Cooperative Agreement with the End in Africa Project managed by Family Health International 360. The contents are the responsibility of the authors and do not necessarily reflect the views of USAID or the United States Government.

**REFERENCES**


