

Research article

Assessment of Soil-Transmitted Helminths Infections, Malnutrition And Anemia among Primary School Children

Desalegn Amenu

College of Natural and Computational Science, Wollega University, P.Box, 395, Nekemte, Ethiopia
E-mail: wadadesalegn@gmail.com

Abstract

Soil-transmitted helminths (STHs) are major public health problems in several tropical and subtropical developing countries with poor socio-economic status. In Tanzania published data suggest that all regions have some level of infection with some areas having prevalence of up to 100%. Children are found to have the highest prevalence and infection intensities and are also very vulnerable to the effects of worm infection which includes nutritional deficiencies which aggravate malnutrition and worsening the rates of anemia. Prior to the implementation of any control programme, WHO recommends a baseline survey in school children to determine the prevalence and intensity of infections as governments need to target treatment appropriately, based on reliable and up-to-date information on the geographical distribution of infection. The main aim of this review paper is to determine the prevalence and intensity of STH infections, malnutrition and anaemia among primary school children. With the observed low prevalence of STH, selective treatment is recommended as a chemotherapeutic method of controlling STH in the district. Studies that are going to establish the cause of the observed prevalence of malnutrition are also recommended.

Keywords: Soil-transmitted, public health, Malnutrition and Anemia

1. Introduction

Soil-transmitted helminths are major public health problems in several tropical and subtropical developing countries with poor socio-economic status. The three major Soil-Transmitted Helminths (STH), *Ascaris lumbricoides* (roundworm), *Trichuris trichiura* (whipworm) and *Necator americanus/Ancylostoma duodenale* (the hookworms) are amongst the most widespread parasites worldwide (Vercruysse et al., 2011). Children are the group with the highest prevalence and infection intensities and are also very vulnerable to the effects of worm infection including nutritional deficiencies which aggravate malnutrition and worsen the rates of anemia and impaired physical and mental development contributing significantly to school absenteeism (WHO, 2010, Saathoff et al., 2004).

Periodic treatment of the endemic population with a broad spectrum antihelminthic drug has been advocated as a cheap and effective means of reducing the worm burden and its related morbidity (Andrade et al., 2001). WHO recommends that in high-risk communities, which are communities with prevalence of any STH infection among school-aged children being more or equal to 50%, all school-age children (enrolled and not enrolled) should be treated twice each year. When prevalence of any STH infection is less than 20%, large-scale preventive chemotherapy interventions are not recommended. Affected individuals should be dealt with on a case-by-case basis (WHO, 2006).

2. Overview

Soil-transmitted helminths (STHs) are among the most common of all chronic human infections, occurring predominantly in areas of poverty and inadequate hygiene and sanitation in the developing world (Brooker and Bundy, 2009). More than one dozen different species of soil-transmitted helminths infect humans, especially in the tropical and subtropical parts of the developing world. However, four nematodes in particular stand out because of their widespread prevalence and distribution that result in hundreds of millions of human infections. These include the large roundworm, *Ascaris lumbricoides*, the whipworm *Trichuris trichiura*, and two species of hookworm, *Necator americanus* and *Ancylostoma duodenale*. The WHO estimates that almost 2 billion people are infected with one or more of these soil-transmitted helminths, accounting for up to 40% of the global morbidity from infectious diseases, exclusive of malaria (Hotez et al., 2003).

For all human soil-transmitted helminths studied to date, which so far includes *Ascaris lumbricoides*, *Trichuris trichiura*, and hookworms, worm burdens exhibit a highly over dispersed distribution so that most individuals harbor just a few worms in their intestines while a few hosts harbor disproportionately large worm burdens (Hotez et al., 2003, 2006). As a rule, 20 percent of the host population harbors approximately 80 percent of the worm population. This over dispersion has many consequences, both with regard to the population biology of the helminths and the public health consequence for the host, because heavily infected individuals are simultaneously at highest risk of disease and the major source of environmental contamination (Hotez et al., 2003).

2.1. Prevalence and Intensity of STH infections in school children

In terms of the disease burden in school-age populations in developing countries intestinal helminth infections rank first among the causes of all communicable and non communicable diseases (Montresor et al., 2002). Peak levels of infection typically occur in hosts aged between 10 and 14 years in endemically infected communities (Galvani, 2005). Age-dependent patterns of infection prevalence are generally similar among the major helminth species, exhibiting a rise in childhood to a relatively stable asymptote in adulthood (Hotez et al., 2006). Epidemiological studies of STH infections have shown that the prevalence and intensity of infection are highest among children 4 – 15 years of age (Norhayati, 2003). Therefore school-age children are the group that bears the greatest prevalence and worm intensities. This was reported in a cross sectional study carried out in school children in Zarima town, North West Ethiopia, where it was observed that 82.4% of the study subjects were infected with one or more parasites. From soil-transmitted helminths, *Ascaris lumbricoides* was the predominant isolate (22%) followed by Hookworms (19%) and *Trichuris trichiura* (2.5%) (Abebe et al., 2011). Another study on school aged children in, Delta State, Nigeria, reported that 54.70% were infected by soil-transmitted helminths. Among these *A. lumbricoides* had the highest overall infection rate of 48.41%.

Morbidity from soil-transmitted helminths infections and the rate of transmission are directly related to the number of worms harbored in the host i.e intensity of infection, which is the main epidemiological index used to describe Soil-transmitted helminth infection and it is measured by the number of eggs per gram of faeces, generally by the Kato-Katz faecal thick- smear technique (Bethony et al., 2006).

Soil-transmitted helminths infections rarely cause death. Instead, the burden of disease is related less to mortality than to the chronic and insidious effects on the hosts' health and nutritional status (Stephenson et al., 2000). Chronic STH infections resulting from *Ascaris lumbricoides*, *Trichuris trichiura*, and hookworm can dramatically affect physical and mental development in children (WHO, 2002). There is now a substantial body of research that clearly demonstrates how STH infections impair healthy nutrition (Stephenson et al., 2000).

The three most frequently used indicators of nutritional status of children i.e. height-for-age, weight-for-age and weight-for-height are based on weight and height measurement (FAO, 2012). Based on these, a child is considered stunted if the child is too short for his/her age. Stunting reflects failure to receive adequate nutrition over a long period of time and is affected by recurrent and chronic illness. Height-for-age, therefore, represents the long-term effects of malnutrition in a population and is not sensitive to recent, short term changes in dietary intake

(National Bureau of Statistics, 2010). The weight-for-height data assesses whether or not the child is wasted. A child is considered wasted if the child is too thin, that is, weighs too little for his/her height. Wasting is an indicator of acute or recent nutritional deficits and is closely tied to mortality risk. The weight-for height indicator also can be used to assess the extent to which children are overweight or obese, which is an increasing problem among children worldwide. Finally, the weight-for-age indicator provides an assessment of whether a child weighs too little for his/her age. A child can be underweight for his/her age because the child is stunted, wasted, or both (National Bureau of Statistics, 2010). However, WHO recommends that acute malnutrition among children and adolescents 5-19 years be assessed by calculating Body Mass Index (BMI), and then adjusting for age to generate BMI for- age. BMI is calculated based on the weight (in kg) divided by the square of the height (in m) of the individual. BMI-forage should be presented as Z-scores based on the 2007 WHO Growth Reference (WHO GR) for children and adolescents 5 to 19 years of age (Holland, 2011).

Several studies have established an association between intensities of STH infections and stunting or wasting. For instance, in a study done on school children in Ecuador it was observed that children with high intensity of infections were more stunted than the other children. Linear regression analysis confirmed a significant relationship ($p < 0.05$) between total worm burden, *A. lumbricoides* burden and degree of stunting, while no relationship could be found with wasting (Andreade et al., 2001). Almost similar findings were reported by Andy and Palmer in a study done in Nigeria, where anthropometric measurements indicated that 17.84% of the subjects were below the third percentile of weight (wasted) and 28.28% were below the third percentile of height (stunted). The data further revealed that there was no relationship between intensity of infection and wasting since among the uninfected group more underweight subjects 21.03% were recorded than moderately infected subjects (12.5%).

However children with high intensity of infections were more stunted than the other children (Andy and Palmer, 2005). However slightly different results were found by Adefioye and his associates in a study done in Nigeria where it was observed that 17% of the children were below the third percentile for weight (wasted) while 14% were below the third percentile for height (stunted), and analysis showed that there was a relationship between intensity of infection and wasting since there were fewer underweight pupils (13%) with normal stool than those moderately infected (35%) ($P < 0.05$) (Adefioye et al., 2011).

1.3. Effects of STH infections on Hemoglobin levels of school children

Anemia is defined as a clinical condition characterized by reduction in hemoglobin (Hb) concentration of blood below the normal for the age, sex, physiological condition and altitude above sea level of that person. It is a public health problem that affects populations in both rich and poor countries. Although the primary cause is iron deficiency, it is seldom present in isolation. More frequently it coexists with a number of other causes, such as malaria, parasitic infection, nutritional deficiencies, and Hemoglobinopathies (WHO, 2008). The World Health

Organization estimates that two billion people suffer from anaemia in the world (WHO, 2000) and iron-deficiency anaemia affects about 1.3 billion people, with the highest prevalence and morbidity being in young children and pregnant women (Gillespie et al., 1991). Morbidity due to soil-transmitted helminths can be alleviated through effective control measures, of the three measures needed for effective control of STH infections i.e. good environmental sanitation, health education and chemotherapy, improving environmental sanitation and health education are preventive and has a long term impact. Good environmental sanitation and a high standard of living have resulted in a reduction in the prevalence of intestinal parasites in developed countries (Ananthakrishnan and Das, 2001).

Anthelmintic drug treatment (“deworming”) is aimed at reducing morbidity by decreasing the worm burden. Repeated chemotherapy at regular intervals (periodic deworming) in high-risk groups can ensure that the levels of infection are kept below those associated with morbidity (Hotez, 2006). Improved sanitation is aimed at controlling transmission by reducing soil and/or water contamination and health education is aiming at reducing transmission and reinfection by encouraging healthy behaviors (Montresor, 2002). Anthelmintic treatment can be dispensed through health services (maternal and child health and antenatal clinics), school health programmes, and community interventions directed at other vulnerable groups (such as adolescent girls) (WHO, 2004).

Since higher prevalence and burden of worm infestation is seen among the school-age children, treatment of this age-group is expected to reduce transmission and therefore prevalence in the entire community (Ananthakrishnan and Das, 2001). However it is known that an important factor in STH treatment is reinfection, as it has been observed that after community-wide treatment, rates of hookworm infection reach 80% of pretreatment rates within 30–36 months. *A.lumbricoides* infection reached 55% of pretreatment rates within 11 months and *T trichiura* infection reached 44% of pretreatment rates within 17 months (Bethony et al, 2006).

1.4. Control of Soil-Transmitted Helminths

The burden of disease associated with helminth infections (schistosomiasis and soil-transmitted helminth (STH) infections) is enormous, with at least 2 billion people affected worldwide. This is being increasingly recognized as a significant public health problem, particularly in developing countries, where poverty, poor nutrition, inadequate sanitation, lack of clean drinking-water and minimal health care prevail (WHO, 2004). Soil-transmitted helminths infections cause morbidity, and sometimes death, by; affecting nutritional status Affecting cognitive processes and; causing complications that need surgical intervention (Montresor, 2002). Although these helminths can infect all members of a population, the most vulnerable groups i.e. those who are at most risk, and who would benefit most from preventive interventions are ; pre-school (age 2–5 years) and school-age children, adolescent girls, and women of childbearing age (WHO,2004).

Morbidity due to soil-transmitted helminths can be alleviated through effective control measures, of the three measures needed for effective control of STH infections i.e. good environmental sanitation, health education and chemotherapy, improving environmental sanitation and health education are preventive and has a long term impact. Good environmental sanitation and a high standard of living have resulted in a reduction in the prevalence of intestinal parasites in developed countries (Ananthakrishnan and Das, 2001).

Anthelmintic drug treatment (“deworming”) is aimed at reducing morbidity by decreasing the worm burden. Repeated chemotherapy at regular intervals (periodic deworming) in high-risk groups can ensure that the levels of infection are kept below those associated with morbidity (Hotez, 2006). Improved sanitation is aimed at controlling transmission by reducing soil and/or water contamination and health education is aiming at reducing transmission and reinfection by encouraging healthy behaviors (Montresor, 2002). Anthelmintic treatment can be dispensed through health services (maternal and child health and antenatal clinics), school

health programmes, and community interventions directed at other vulnerable groups (such as adolescent girls) (WHO, 2004).

Since higher prevalence and burden of worm infestation is seen among the school-age children, treatment of this age-group is expected to reduce transmission and therefore prevalence in the entire community (Ananthkrishnan and Das, 2001). However it is known that an important factor in STH treatment is reinfection, as it has been observed that after community-wide treatment, rates of hookworm infection reach 80% of pretreatment rates within 30–36 months. *A.lumbricoides* infection reached 55% of pretreatment rates within months and *T.trichiura* infection reached 44% of pretreatment rates within 17 months (Bethony et al, 2006). School based survey is thus required to provide reliable and up to date data on the prevalence and intensity of STH in the district.

References

- [1] Abebe A., Asmamaw A., Zelalem A., Yitayal S., Takele T., Biniam M., Wubet B., Simon G. and Baye G. (2011). Soil-transmitted helminths and *Schistosoma mansoni* infections among school children in zarima town, northwest Ethiopia, *BMC Infectious Diseases*, 11:189.
- [2] Adefioye O.A., Efunshile A.M., Ojurongbe O., Akindele A.A., Adewuyi I.K., Bolaji O.S., Adedokun S.A and Adeyeba A.O. (2011). Intestinal Helminthiasis among School Children in Ilie, Osun State, Southwest, Nigeria, Sierra Leone, *Journal of Biomedical Research*,3(1): 36-42.
- [3] Ananthkrishnan S. and Das P. K. (2001). Integrated programme for control of geohelminths: A perspective. *The National Medical Journal Of India*. 14:3.
- [4] Brooker S. and Bundy D.A. P. (2009). Soil-transmitted Helminths (Geohelminths). In: Cook G.C. & Zumla A.I. *Mansoon's tropical disease*, 20th edition. Harcourt private limited. Newdelhi India 85: 1515 – 1544.
- [5] Food and Agriculture Organization. Anthropometric Assessment of Nutritional status. [Internet][Cited 2012 Jan 26]. Available from <http://www.fao.org/docrep/012/w0931e/w0931e17.pdf>.
- [6] Hotez P.J., Bundy D.A.P., Beegle K., Brooker S., Drake L., De Silva N., Montresor A., Engels D., Jukes M., Chitsulo L., Chow J., Laxminarayan R., Michaud C.M., Bethony J., Correa-Oliveira R., Xiao S. H., Fenwick A., and Savioli L. (2006). Helminths infections: Soil-Transmitted Helminth Infections and Schistosomiasis, *Disease Control Priorities in Developing Countries*, WHO, 2nd edition, 24: 467 – 480.
- [7] Hotez P.J., De Silva N., Brooker S. and Bethony J. (2003). Soil Transmitted Helminth Infections: The Nature, Causes and Burden of the Condition, *Disease Control Priorities Project, Working Paper No. 3*.
- [8] National Bureau of Statistics, (2010). Tanzania Demographic and Health Survey, Preliminary report, Dar-es-Salaam, Tanzania.
- [9] Saathoff E., Olsen A., Kvalsvig J.D. and Appleton C.C. (2004). Patterns of geohelminth infection, impact of albendazole Treatment and re-infection after treatment in schoolchildren from rural KwaZulu-Natal/South-Africa, *BMC Infectious Diseases*, 4:27
- [10] Stephenson L.S., Latham M.C. and Ottesen E.A. (2000), Malnutrition and parasitic helminth infection. *Parasitology* 121(Suppl): S23–S38.

[11] World Health Organization (2000). Report on malnutrition worldwide, Switzerland, Geneva.

[12] World Health Organization (2002). Prevention and control of schistosomiasis and Soil – transmitted helminthiasis, WHO technical report series, 912, Geneva, Switzerland.

[13] World Health Organization. (2006). Preventive Chemotherapy in Human Helminthiasis. Coordinated use of anthelmintic drugs in control interventions: A manual for health professionals and programme managers. 20, Avenue Appia. 1211 Geneva 27, Switzerland.

[14] World Health Organization (2008). Worldwide prevalence of anaemia 1993–2005, WHO Global Database on Anaemia.