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Impact of Schistosomiasis in Kasansa Health Zone in Democratic Republic of Congo

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IMPACT OF SCHISTOSOMIASIS IN KASANSA HEALTH ZONE IN
DEMOCRATIC REPUBLIC OF CONGO

by

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MD, UNIVERSITY OF MBUJIMAYI

A Thesis Submitted to the Graduate Faculty
of Georgia State University in Partial Fulfillment
of the Requirements for the Degree
MASTER OF PUBLIC HEALTH
ATLANTA, GEORGIA

APPROVAL PAGE

**IMPACT OF SCHISTOSOMIASIS IN KASANSA HEALTH ZONE IN
DEMOCRATIC REPUBLIC OF CONGO**

by

MBUYI MADELEINE KABONGO

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DEDICATION PAGE

To almighty God, for the strength he gave me to start and complete the MPH program despite other obligations including taking care of my four little children and working full time.

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I also acknowledge my committee, Dr. Richard Rothenberg, MD, MPH, FACP and Christine Stauber, PHD, MS for their guidance and support.

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1. Kabongo M (2003) Risk Factors of Cholera in the City of Mbuji-Mayi. Thesis of graduate medical school. University of Mbujimayi.
2. Kabongo M & Nzevu L (1997) .The Profile of Blood Pressure and Prevalence of Hypertension at the University of MbujiMayi. Dissertation of undergraduate medical school. University of Mbujimayi.

IMPACT OF SCHISTOSOMIASIS IN KASANSA HEALTH ZONE IN DEMOCRATIC REPUBLIC OF CONGO

STUDENT'S NAME: Mbuyi Madeleine Kabongo, MD

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ABSTRACT

Background: Schistosomiasis is a chronic parasitological disease and constitutes one of the major neglected public health problems in the world. The consequences that this disease causes in the population are subject of controversy. The aim of this study was to assess the impact of schistosomiasis in term of malnutrition, anemia and low school performance in an endemic region, naïve of interventions.

Methods: The study was conducted in Kasansa health zone in Democratic Republic of Congo where schistosomiasis has been endemic for decades. School aged children were recruited at home. From each child, anthropometric measures, biological and laboratory exams were obtained. The questionnaire was used for economic status, behavior and other factors related to schistosomiasis. Regression logistic was used to control confounding factors. A 95% confidence interval was used for statistically significance.

Results: The proportion of malnutrition was 53.8%, anemia 67.0% and low school performance 41.1%. In this health zone, the study found and confirmed a high proportion of children who are infected with *S. mansoni* (89.3%) and malaria (65.1%).

Conclusions: This study showed high proportions of complications that are usually reported as associated with schistosomiasis, among school aged children in the health zone of Kasansa. Future studies are needed to show causality and to find efficient ways to control these morbidities.

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Chapter I

INTRODUCTION

1. Background

Schistosomiasis, or bilharziasis is a tropical parasitic disease caused by five main species of blood fluke (schistosomes) that penetrate the skin of people in the water and live within the perivesical (*Schistosoma haematobium*) or mesenteric (other species) venous plexus according to World Health Organization (WHO) and other authors (WHO,2010; Gryseels *et al.* 2006).

This disease is a major public health problem in many regions including Africa, the Middle East, Asia and South America. It is listed as one of the neglected tropical diseases (NTD) worldwide and is a symptom of poverty. It is the second most prevalent tropical disease, after malaria, and a leading cause of severe morbidity in large areas of the world as reported by the Center for Disease Control and Prevention (CDC, 2010).

Approximately 700 million people world-wide may be at risk of infection and more than 207 million are infected worldwide, leading to the loss of 1.532 million disability-adjusted life years (DALYs), of which 77 % are in sub-Saharan Africa (WHO, 2010; CDC,2010, Gryseels *et al.*, 2006).

Most persons infected with schistosomes do not suffer from severe hepatosplenic disease (caused by *Schistosoma mansoni* and *S. japonicum*) or bladder calcification and hydronephrosis (caused by *S. haematobium*), but from less dramatic morbidities such as anemia, fatigue, malnutrition, or impaired cognitive development. Because the number of

infected persons who experience the lower grade pathologies is high, the overall impact on DALYs lost due to these manifestations is greater than that of severe pathologies that are more directly life threatening (King *et al.* 2005).

Poor communities without access to safe water and adequate sanitation are more infected since agricultural, domestic and recreational activities expose them to infested water (WHO, 2010).

Of all the age groups, school-age children – aged between around 6 and 15 years – are the most exposed and suffer the most because they are traditionally responsible for water-related household chores in poor countries and because they like to spend their free time swimming (The Carter Center website, 2012; CDC, 2010; Badr, 2009; Mfuh, Lukong, & Ogbu, 2011).

The heavy burden of disease in this age group has negative consequences for a child's long term overall development (United Nations System, 2002). Although severe disease has become less common thanks to modern drugs, indirect morbidity such as chronic anemia, malnutrition, cognitive and physiological impairment, and poor school performance have been reported to be associated with schistosomiasis (Gryseels *et al.* 2006).

However, in the Democratic Republic of Congo (DRC), although the increased number of people infected with schistosomiasis (17,128,804 to 19,157,807) and of those who need preventive treatment (47,302,233 to 52,905,446) from 2006 to 2010, there is no

report of the number of people who are targeted nor for those who are treated (WHO, 2012). It is therefore probable to find a high prevalence of these morbidities.

A recent parasitological survey on intestinal schistosomiasis among third grader children in Kasansa health zone in DRC reported more than 90% prevalence in some areas in this region. This prevalence is very high according to WHO guidelines (Montresor *et al.*,1998).

2. Purpose of study

The main purpose is to evaluate the impact of schistosomiasis among school age children in Kasansa health zone, DRC. This study will examine morbidities usually considered as associated to schistosomiasis including malnutrition, anemia and school performance; also associations of these morbidities to schistosomiasis related factors will be assessed.

This study is important because the high prevalence of schistosomiasis in Kasansa health zone suggests high prevalence of these morbidities and negative overall children' health. The results of this study could provide valuable insights to the population regarding their health risk. Also, public health professionals could use these results to determine specific interventions strategies that match the needs of the population who have malnutrition, anemia and low school performance, as well as those who are at risk. Additionally the results could be used as an argument to programs that fight against schistosomiasis and its morbidities.

The specific objectives are:

-to determine the prevalence of malnutrition in the community with high prevalence of schistosomiasis

-to determine the prevalence of anemia in the community with high prevalence of schistosomiasis

-to determine the prevalence of low school performance in the community with high prevalence of schistosomiasis

Chapter II

REVIEW OF THE LITERATURE

The literature review will examine basic features of schistosomiasis and clinical outcomes. The following chapter is dedicated to presenting scientific literature that supports inclusion of the variables of interest in this study.

a. Pathophysiology of schistosomiasis

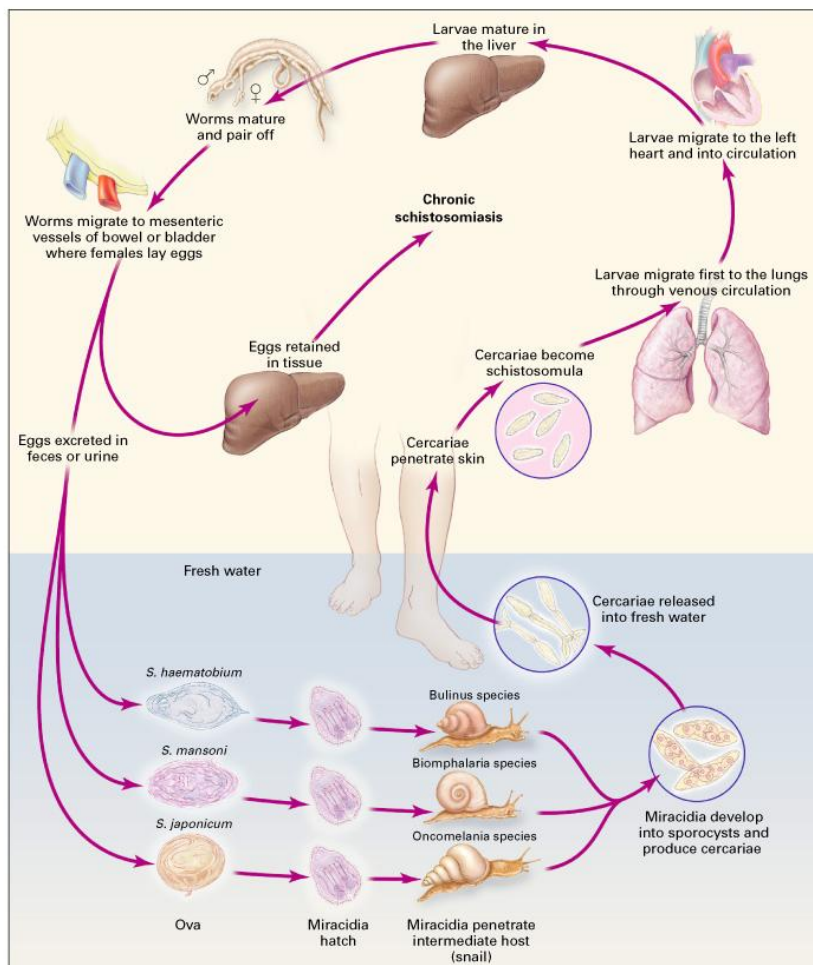


Figure 1 Life Cycle of the Schistosome. (Ross et al. 2002).

The cercariae, larva of schistosome, penetrate the skin of humans who come in contact with fresh water, and then enter their capillaries and lymphatic vessels. After several days, the cercariae migrate to the portal venous system where they form pairs that migrate, depending on the type of schistosome, to the superior mesenteric system, the inferior mesenteric system, the superior hemorrhoidal veins or the vesical plexus and veins draining the ureters. The eggs begin to be produced four to six weeks after infection and continue for the life of the schistosome (three to five years); they pass into adjacent tissue and are shed in feces or urine. When the eggs hatch, they release miracidia that infect freshwater snail that in turn release cercariae and the cycle starts again (Ross *et al.*, 2002).

b. Clinical manifestations and complications of schistosomiasis

Schistosomiasis can be presented in two forms: acute and chronic (Gryseels *et al.* 2006, Ross *et al.*,2002).

Acute schistosomiasis is characterized by cercarial dermatitis (CD) and Katayama syndrome (KS). CD is a macular and papular, pruritic rash that manifests within several hours of exposure to contaminated water and may persist for several days. The symptoms of KS manifest weeks to months after individuals are first exposed to schistosome infection or following heavy reinfection and are characterized by rapid onset fever, fatigue, myalgia, malaise, headache, nonproductive cough, and eosinophilia (Gryseels *et al.*,2006; Ross *et al.*, 2002; Lambertucci,1998). Recovery is spontaneous in the majority of people, but some can develop serious disease.

The chronic infection is due to eggs that are trapped in the tissues during the perivesical or peri-intestinal migration or after embolization in the liver, spleen, lungs, or cerebrospinal system, resulting in granulomatous inflammation (Gryseels *et al.* 2006). These manifestations are variable and depend on the location of the adult schistosome and constitute complications (Burke *et al.* 2009).

Gastrointestinal schistosomiasis is characterized by chronic or intermittent abdominal pain and discomfort, loss of appetite and diarrhea that commonly contains occult blood. In the hepatic sinusoids, the eggs deposition causes granuloma and hepatomegaly (Burke *et al.*, 2009; Gryseels *et al.*, 2006).

The Genitourinary tract disease is a specific feature of *S. haematobium* infection. Eggs are deposited in the wall of the bladder and the ureters and possible consequences include hematuria, dysuria, lesions of the bladder, renal colic, hydro ureter and hydronephrosis, and renal failure (Botros *et al.*, 2008).

The complications that may develop with schistosomiasis usually occur in individuals harboring many parasites and eggs, especially when the eggs and parasites have migrated to other organs. In general, complications usually involve the cardiopulmonary, CNS, gastrointestinal, and urinary tracts along with the liver and spleen. Some of the major complications are hypertension, seizures, bacterial infections, urinary obstruction, organ damage or destruction, and death.

c. Anemia

“Anemia is a condition in which the number of circulating red blood cells concentration of hemoglobin (Hb), or the percentage volume of packed red blood cells in a centrifuged blood specimen (hematocrit) is lower than the normal “(Smith, 2010).

In schistosomiasis, anemia results from four processes: iron deficiency due to extra-corporeal blood loss; splenic sequestration; autoimmune hemolysis; and anemia of inflammation (Friedman *et al.*, 2005). It is hypothesized that the iron deficiency is the most important mechanism.

Iron deficiency anemia is determined by the level of Hb below two standard deviations (-2SD) of the distribution mean for Hb in a normal population of the same gender and age who live at the same altitude. It is expected to have 2.5 % of the population to be below this threshold, but if goes to up to 5.0%, it becomes a public health problem (WHO, 2001). Developing countries have an elevated frequency of anemia because of increased risk of infectious diseases, poverty, and malnutrition. (Khambalia *et al.* 2011). Several studies have examined the relationship between the three most prevalent schistosoma species that infect humans and anemia.

Considering that anemia was one of the major public health problems affecting more than half of school children along the coast in Tanzania, an investigation of risk factors was conducted; Schistosomiasis was found to be a significant predicting factor in the region (Tatala *et al.*, 2008). But in the North-western area of Tanzania, another team of researchers assessed the prevalence of anemia and organomegaly and their relationship

with parasitic infections among school children. They found no association (Mazigo *et al.*, 2010).

In Bamako, Mali, a study was done to assess the prevalence of iron deficiency anemia and the effect of iron supplementation among school children infected with schistosomiasis; they found that iron deficiency was prevalent in these children and the level of hemoglobin and ferritin increased after treatment (Ayoya *et al.*, 2009).

d. Nutritional status (malnutrition)

According to the WHO (1995), anthropometry reflects both health and nutritional status. Thus, it is a valuable, but currently underused, tool for guiding public health policy and clinical decisions. Anthropometric indices (i.e. height-for-age, weight-for-age and weight-for-height) constitute a tool to measure and quantify the severity of malnutrition and provide a summary of the nutritional status of all children in the measured group. (United Nations system, 2002).

Malnutrition literally means “bad nutrition” and technically includes both over- and under- nutrition. In the context of developing countries, under-nutrition is generally the main issue of concern (WHO, 2012b). The anthropometric measures are interpreted as follows:

- **Weight-for-age:** Low weight-for-age index identifies the condition of being underweight, for a specific age
- **Height-for-age:** This index is an indicator of past undernutrition or chronic malnutrition

- Weight-for-height: This index helps to identify children suffering from current or acute undernutrition or wasting and is useful when exact ages are difficult to determine.

Several studies reported association between schistosomiasis and malnutrition.

A cross sectional study of 461 schoolchildren in Brazil, done to evaluate the relationship between stunting, *Schistosoma mansoni* infection and dietary intake in schoolchildren, found 55.1% of children with *S. mansoni* infection and 22.1% were stunted (Assis *et al.* 2004). Gurarie D *et al.* (2011) examined the likely impact of different schistosomiasis treatment regimens on age-specific risk for growth retardation and reinfection. The results suggested the need of repeated treatment through primary school years to optimally prevent the disabling sequelae of stunting and undernutrition.

In Southeast Nigeria, a study was conducted to evaluate the impact of *S. haematobium* infection on the nutritional status of school children. Out of the total of 403 school children who participated in the study, 320 (79.4%) were infected with *S. haematobium*; Children with lower body weight, lower height and lower arm circumference were significantly more infected with *S. haematobium* than their mates with higher anthropometric parameters ($p < 0.05$). Findings from this study suggested that *S. haematobium* infection may affect the growth and the nutritional status of children adversely (Uneke & Egede in Nigeria, 2009).

e. School performance

The relationship between schistosomiasis and low school performance reside in the fact that schistosomiasis causes anemia and undernutrition, which are closely linked to

impaired cognitive performance and development. There is much evidence of that (Jukes *et al.*, 2002).

Results of studies about the effect of schistosomiasis on cognitive development are different from one study to another.

A cross-sectional study done in Philippines examined the independent effect of helminthiasis on cognitive function among children aged 7 to 18 years old. The authors found association of helminthes infection with lower performance in three of the four cognitive domains examined in the study (Ezeamama AE *et al.*, 2005).

In Sichuan, China a study investigated the effects of helminthiasis treatment on the cognitive function (working memory), found that there were a significant effect of praziquantel treatment on three of the five cognitive tests, fluency, picture search, and free recall, with effects being strongest in the youngest children. Younger children and those who were physically the most vulnerable were likely to benefit the most from the treatment of *S. japonicum* infection in terms of improved performance on tests of working memory (Nokes *et al.*, 1999).

A systematic review of randomized controlled trials, done to summarize the effects of anthelmintic drug treatment on growth and cognitive performance in children, did not found sufficient evidence as to whether this intervention improves cognitive performance (Dickson R *et al.*, 2000).

In DRC, primary school children were tested for cognitive ability, evaluated for hemoglobin level and intestinal parasites. The study showed improvement in certain

aspects of cognitive ability after treatment with vermifuge and iron supplement (Boivin MJ & Giordani B, 1993).

Chapter III

METHODOLOGY

3. a. Data source and study population

The data for this study came from “Epidemiology and control of schistosomiasis in Democratic Republic of Congo (DRC) of today” research project, funded by WHO/TDR/RCS and directed by professor Pascal Lutumba, the principal investigator.

The objective of this project was to update the situation of schistosomiasis in DRC in terms of research capacity, efficiency of surveillance and control strategies, burden and impact. A final aim of this project was to contribute to research capacity building, to identify the best ways to control schistosomiasis and to increase awareness of policy makers by the demonstration of impact of schistosomiasis in affected communities. Studies of this project were done at the health zone level among primary school children.

Since the adoption of primary health care strategy in 1980, the healthcare system in DRC is structured in three levels: central, intermediate and operational. The central level (national) is strategic and regulatory. The intermediate represent the central in provinces it is subdivided in health zones which constitute the operational unit for planning and implementing primary health care.

This study was done in the health zone of Kasansa which is in the Kasai oriental province.

Parasitological baseline surveys were performed to describe current situation on schistosomiasis infection. Based on the WHO guidelines for prevalence study, a sample size of 335 children were included in the study (Montresor *et al.*, 1998). After this first phase which is consisted in estimation of schistosomiasis prevalence, a household study was conducted for morbidities and included 203 children.

Urine and stool samples were collected from each selected child, and tested for presence and intensity of schistosomiasis. Diagnosis was done by microscopy using direct examination, Comburtest® for detection of blood in urine, Urine filtration and Kato Katz technique.

A questionnaire regarding household information, water sources, sanitation, previous schistosomiasis signs and treatment, gaps in school attendance was completed by the parents from whom consent was obtained.

Ethical considerations

The research protocol for the project “Epidemiology and control of schistosomiasis in Democratic Republic of Congo (DRC) of today” was reviewed and approved by the ethics committee of the Institute of Public health, University of Kinshasa.

The Georgia State University Institutional review Board reviewed and approved the protocol of this present study.

Study site

This present study looked at data of the health zone of Kasansa.

This picture below was taken during the parasitological survey.



Fig 2: Reception and exam table during the survey (Lutumba P, 2011)

The health zone of Kasansa is located in the South-West of Kasai Oriental province (see figure 3), the population was estimated to 170,576 in 2005. The population lives mainly from agriculture, domestic small livestock, fishing, small business and artisanal diamond. Several rivers cross the region including Lufingila, Mutokoyi, Nsangu, Kalelu, Mbuji-Mayi Nsengansenga, Muya, Mulunguyi, Monzo and Lac Lomba (see figure 4).

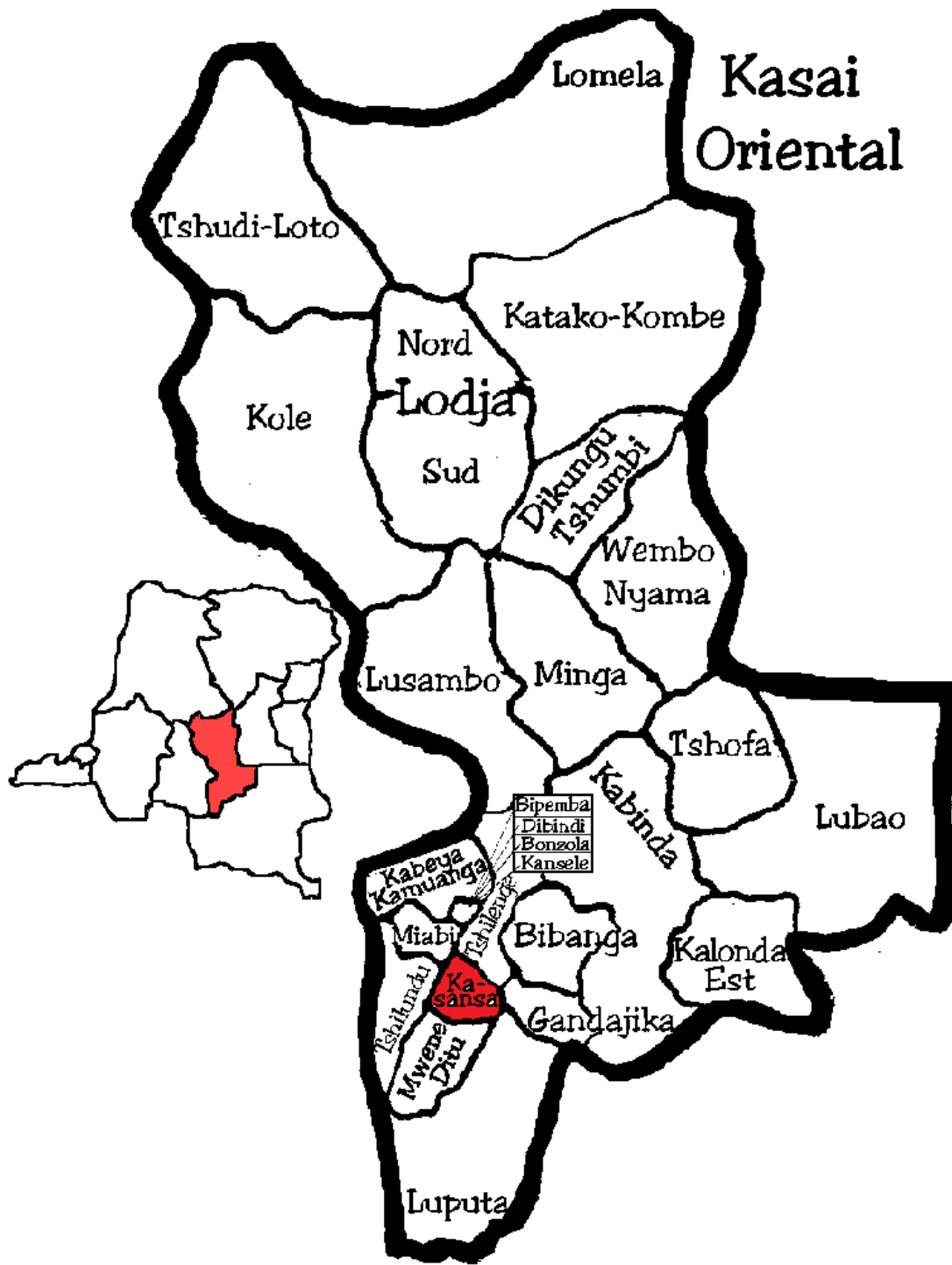


Figure 3: map of DRC, Kasai Oriental province (Lutumba P, 2011).

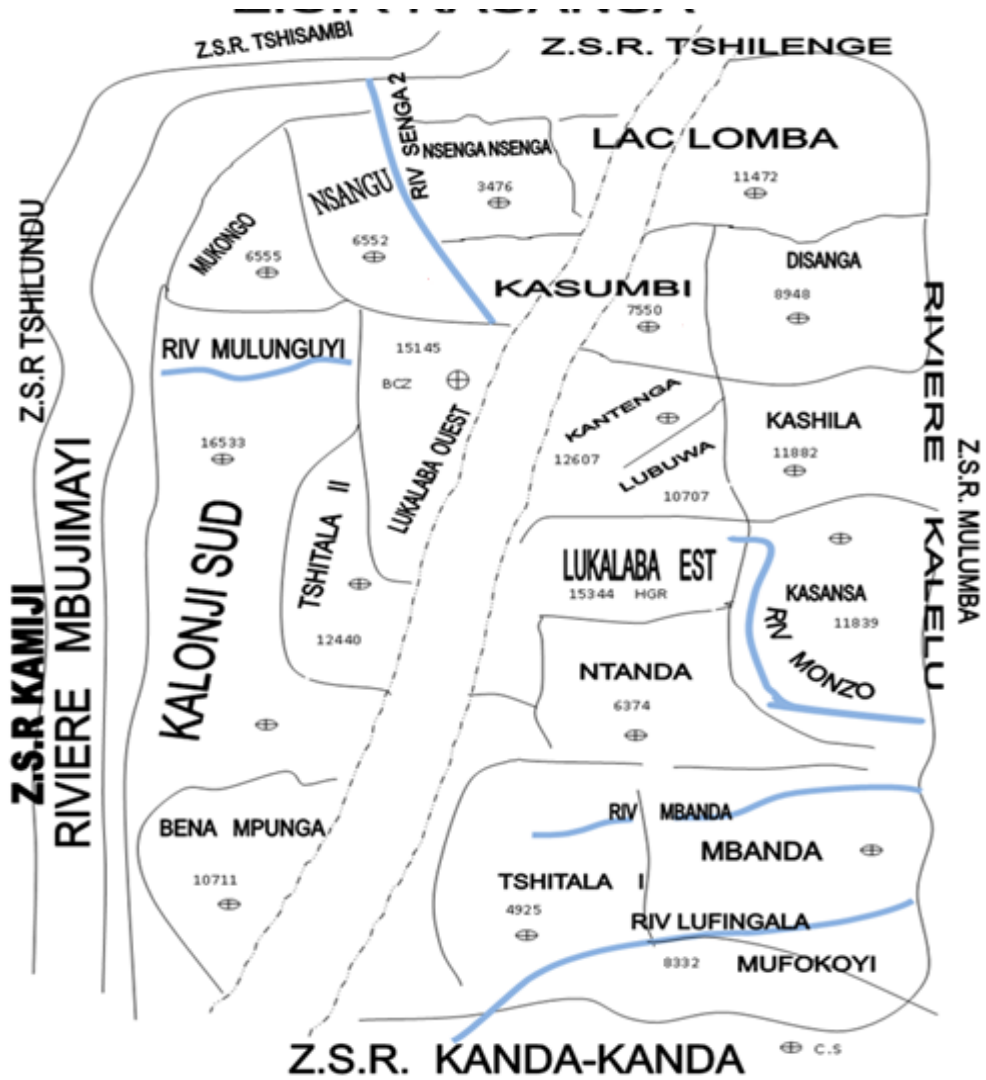


Figure 4: map of Kasansa Health zone (Lutumba P, 2012)

3. b. Study measures

The study endpoints were nutritional status, anemia and school performance.

The following parameters were recorded for each child: age, sex, grade, weight, height, hemoglobin (Hb), and malaria by using rapid diagnostic test. The examiner observed current schistosomiasis signs and asked questions regarding economic status, behavior etc... For poverty level, we used a cut-off of 1 US\$ as a standard used for underdeveloped countries (Couch KA, & Pirog MA, 2010).

Height was measured using a portable stadiometer and weight was measured with a digital scale.

Hb was measured by using Hemocue Hb201® machine and reported as grams of hemoglobin per deciliter of blood (g/dl).

Nutritional status

Nutritional status was assessed using anthropometric indices z-scores.

HAZ was used for chronic malnutrition as schistosomiasis is a chronic disease.

Height-for-age z-score (HAZ) were calculated to determine nutritional status according to the WHO growth reference for school age children and adolescents (WHO, 2012). In this study, stunting was defined as HAZ equal to or below minus two standard deviation (-2SD) of the WHO reference median.

Anemia

Diagnosis of anemia was based on Hemoglobin concentration below 12g/dl as recommended by WHO.

School performance

School performance was based on the number of times of repeat grade. A student who has repeated grade at least two times was considered as having low school performance.

3. c. Data analysis

Data were double entered and cleaned using Epi Info 2000.

The Statistical Package for the Social Sciences (SPSS) version 18 was used to recode, organize, and analyze the dataset to make it suitable for the study. WHO AnthroPlus software was used to calculate anthropometric indices' z-scores.

Frequency tables were produced to determine the representation of characteristics of the study population, endpoints of this study including anemia, nutritional status and low school performance, as well as factors that can influence these endpoints.

The dependent variable in the models was one of variable listed above (anemia, nutritional status, and school performance); the independent variables were sex, age, grade, schistosomiasis, household income, water source, presence of toilet, malaria, presence of blood in stool, abdominal bloating etc.

To determine whether the associations in the bivariate model were not dependent of other covariates, multivariate logistic regression was performed for each endpoint with different independent variables. Confidence intervals of 95% were used as cut-off for statistical significance.

Chapter IV

RESULTS

4.1 Characteristics of the study population

The total number of children included in this study was 203; 6 were excluded because of lack of stool samples. Out of the 197 remaining, 175 (88.8%) were living in the Kasansa village and 22 (11.2%) were from Lac Lomba village. About three quarters (76.1%) were enrolled in the elementary school EP Kasansa. These children were from the third grade to the sixth, and the proportions are as follow: 6 children (3.0%) in third grade, 80 (40.6%) in fourth grade, 59 (29.9%) in fifth grade and 52 (26.4%) in sixth grade. The gender distribution was about the same with 106 (53.8%) males and 91 (46.25%) females. Children's median age was 12 years with an interquartile range of 3 years, while their median weight was 28 kg with an interquartile range of 9 kg. The median number of people per household was 9 with an interquartile range of 4 people. The majority of the children had light intensity of infection (89.3%).

Faucet was found in none of the household (0 out of 197), the majority of the population was using water from the river (70.1%). The parents' occupation distribution showed 153 (78.5%) farmer, 10 (5.1%) traders, 30 (15.4%) officials and 2 (1%) pastors. The median daily expense for household was 5.5 US\$ with an interquartile range of 2.3 US\$. The median daily expense per person in a household was 0.55 US\$ with an interquartile range of 0.24 US\$. Overall, 178 children (98.8%) live in household with a daily expenses less

than a dollar, corresponding to the poverty level standards used for underdeveloped countries.

The prevalence of children with chronic malnutrition was 53.8 %, 132 children had anemia (67.0%) and 81 (41.1%) had a low school performance.

Among children who have reported repeated grade, 60.8 % reported failure and sickness as reason of repeated grade. About one fifth did not have money to pay for tuition (Table 1).

Table 1: Reason for repeated school grade

Reason	n	Percentage
Change in setting	8	8.2%
Mother's death	1	1.0%
Failure	40	41.2%
Absenteeism	4	4.1%
Sickness	20	20.6%
Mother sickness	1	1.0%
Lack of money	23	23.7%
Total	97	100.0%

The total number of children who tested positive for schistosomiasis was 176 (89.3%). River was the most reported as primary source of water to wash clothes, dishes(73.0 %), as well as for bathing (66.8%)., drinking water was from spring (82.1%) or well (17.9%). Almost all indicated that they had a latrine at home (92.9%), about three quarters of the

population presented abdominal pain (73.6%) and 65.1% tested positive for malaria (Table 2).

Table 2. Distribution of factors that can influence endpoints

Variable	n	yes	percentage
Bloated abdomen	196	77	39.3
Abdominal pain	197	145	73.6
River to wash clothes	189	138	73.0
River to bathe	190	127	66.8
Schistosomiasis	197	176	89.3
Latrine at home	197	183	92.9
Previously treated for schistosomiasis	197	61	31.0
Transfusion in the past	197	7	3.6
Malaria	175	114	65.1

Figure 5 shows a 17 years old male with bloated abdomen. This boy was in fifth grade.



Figure N° 5: Seventeen years old and fifth grader with bloated abdomen.

Figure 6 shows the children in Kasansa village playing, swimming and taking water for home at Monzo River which is known for existence of snail and schistosomiasis transmission.



Figure 6: school aged children at Monzo River (Kasansa)

The results of bivariate analysis of the association between the factors that can influence endpoints (independent variables) and anemia (dependent variable) are shown in Table 3.

With anemia as dependent variable, the association was significant with age, river as source of water to wash clothes and previous schistosomiasis treatment. Children aged less than 12 years old had greater odds to have anemia than those who were older. Those who were using the river as source of water to wash their clothes had greater odds to have anemia than those who used well or spring. The odds of having anemia were about one sixth more times in those who had been previously treated for schistosomiasis. Although those who tested positive to schistosomiasis had greater odds for anemia, the association wasn't significant. The odds of having anemia were higher in those with moderate infection.

Table 3. Results of bivariate analysis of factors associated with Anemia

Variable	OR	95% CI
Sex male	1.09	0.60-1.98
Age \leq 12 years	2.31	1.23-4.34
Bloated abdomen	1.67	0.89-3.14
Abdominal pain	1.55	0.80-3.00
Daily expenses \leq 1\$	0.65	0.20-2.12
River wash clothes	2.42	1.24-4.72
River bath	1.77	0.94-3.34
HAZ \leq -2SD	1.31	0.72-2.38
Schistosomiasis	2.00	0.80-4.98
Latrine at home	1.57	0.52-4.75
Previous schist treatment	2.01	1.01-4.01
Transfusion in the past	0.64	0.14-2.97
Malaria	0.66	0.31-1.38
Low school performance	0.73	0.38-1.40
Moderate intensity	10.85	1.42-83.01

The analysis of association between malnutrition (stunting) and the independent variables, revealed that those with bloated abdomen had 1/3 more odds of being stunted than those who did not have bloated abdomen, while the younger were less likely to be stunted. Males were also more stunted than females (Table 4).

As for school performance, younger children, those who used river as source of water to wash clothes or to bathe, and those who had current schistosomiasis infection, had less odds of having low school performance. Stunted children had greater odds of having low school performance (Table 5).

Table 4. Results of bivariate analysis of factors associated with malnutrition

Variable	OR	95% CI
Sex male	2.10	1.18-3.72
Age ≤ 12 years	0.28	0.15-0.51
Bloated abdomen	4.21	2.25-7.89
Abdominal pain	1.51	0.80-2.87
Daily expenses ≤ 1\$	1.54	0.54-4.31
River wash clothes	1.50	0.79-2.87
River bath	1.53	0.83-2.81
Schistosomiasis	0.69	0.27-1.74
Latrine at home	0.62	0.20-1.94
Previous schist treatment	1.49	0.81-2.76
Transfusion in the past	0.33	0.06-1.74
Malaria pos	1.79	0.95-3.36
Moderate intensity	0.85	0.33-2.15

Table 5. Results of bivariate analysis of factors associated with School performance

Variable	OR	95% CI
Sex male	0.73	0.41-1.30
Age \leq 12 years	0.26	0.19-0.36
Bloated abdomen	0.96	0.53-1.72
Abdominal pain	1.29	0.67-2.49
Daily expenses	1.18	0.41-3.40
River wash clothes	0.43	0.22-0.82
River bath	0.43	0.23-0.81
HAZ \leq -2SD	3.57	1.94-6.56
Schistosomiasis	0.38	0.15-0.98
Latrine at home	0.67	0.22-2.01
Previous schist treatment	0.60	0.31-1.12
Transfusion in the past	0.22	0.02-1.94
Malaria	1.24	0.65-2.37
Moderate eggs intensity	0.32	0.10-1

To determine whether the associations of bivariate analysis were not dependent of other covariates, the multivariate logistic regression was performed for each endpoint. The results are shown in the three following tables 6, 7 and 8.

Malaria was excluded from the logistic regression of anemia as dependent variable because it was affecting the association of anemia and the other covariates. Controlling for other factors, only age was significantly associated with anemia.

Adjusting for other factors, there were no changes in the significance of associations with malaria.

When adjusting for other factors, none of the variables remained significantly associated with school performance.

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Table 6. Results of multivariate analysis of factors associated with Anemia

Variable	OR	95% CI
Sex male	0.88	0.43-1.79
Age	3.53	1.33-9.38
Bloated abdomen	1.46	0.69-3.07
Abdominal pain	1.42	0.66-3.05
Daily expenses	1.84	0.42-8.00
Water wash clothes	1.72	0.76-3.86
Schistosomiasis	1.40	0.49-3.99
Latrine at home	1.96	0.56-6.80
Previous schist treatment	1.42	0.65-3.11
Malnutrition	1.40	0.64-3.07
School performance	2.02	0.78-5.20

Table 7. Results of multivariate analysis of factors associated with Malnutrition

Variable	OR	95% CI
Sex	2.95	1.32-6.57
Age	0.25	0.08-0.77
Bloated abdomen	4.73	2.10-10.64
Abdominal pain	1.57	0.63-3.88
Daily expenses	2.15	0.60-7.64
Water wash clothes	2.48	0.86-7.10
Schistosomiasis	0.81	0.13-4.95
Latrine at home	0.84	0.14-4.92
Previous schist treatment	1.44	0.65-3.21
Malaria	1.90	0.86-4.17
Intensity eggs	1.61	0.52-4.95
Anemia	1.65	0.65-4.18
School performance	1.68	0.53-5.34

Table 8. Multivariate analysis of factors associated with low school performance

Variable	OR	95% CI
Sex	0.59	0.17-1.98
Bloated abdomen	0.77	0.25-2.35
Abdominal pain	0.91	0.24-3.36
Daily expenses	2.27	0.45-11.25
Water wash clothes	0.80	0.16-3.84
Malnutrition	1.63	0.47-5.63
Schistosomiasis	0.83	0.76-9.14
Latrine at home	0.40	0.39-4.16
Previous schist treatment	0.72	0.22-2.32
Malaria	1.26	0.41-3.81
Intensity eggs	4.30	0.88-21.03
Anemia	3.22	0.97-10.61

Chapter V

DISCUSSION AND CONCLUSION

Main findings

Proportion of malnutrition was 53.8 %, anemia 67.0% and low school performance 41.1% in the school aged children in Kasansa health zone. This study found and confirmed higher proportions of children infected with *Schistosoma mansoni* (89.3%) and malaria (65.1%).

Age was found to be significantly associated with Anemia even after controlling for other factors, while river as source of water, previous schistosomiasis treatment and eggs intensity lost their significance when adjusting for other factors.

Sex, age and bloated abdomen were found to be associated with stunting; these associations did not change even when adjusting for other variables.

As for low school performance, age, river as source of water and schistosomiasis were found to be protector while stunting had greater odds; none of these factors remained associated significantly after adjustment.

Most of the studies involving the relationship between these morbidities and schistosomiasis evaluated the association with current schistosomiasis infection, while in this study we were looking at their prevalence. However, there are similarities in the findings.

Assis *et al.* (2004) found that 22.1% of children infected with *S. mansoni* were stunted and there were a 2.74 fold higher risk of stunting for heavily infected children than uninfected children; this could be due to the fact that schistosomiasis is endemic anyway in Brazil.

Tatala *et al.* reported high prevalence of anemia among school children along the coast in Tanzania and strong association with schistosomiasis. As for school performance, children infected with *S. Japonicum* had 3.04 times the odds of poor performance in the learning domain than the uninfected children (Azeamana *et al.*, 2005)

This study did not show associations between current schistosomiasis and different endpoints because this pathology is chronic, outcomes are rather seen with time than at the moment of infection. Indeed, children who had schistosomiasis in the past can present complications even they took treatment recently. On the contrary, a child recently infected does not present complications of the disease.

In this study, the proportion of anemia is high but the number of children who have received blood transfusion is very low, suggesting progressive tolerance of chronic anemia. Therefore, it is possible to consider that this anemia is not associated to malaria but to a chronic process. The high prevalence of schistosomiasis suggests its contribution to these complications. The permanent access of children to rivers (73.0%) infested by snails and the number of children with bloated abdomen (39.3%) could also reinforce the implication of schistosomiasis in these morbidities.

In this poor community, it is possible to have a vicious circle where malnutrition can be the cause of anemia and vice versa, and this circle can be aggravated by schistosomiasis.

However, reports of height for height z-scores HAZ determining stunting, clearly show that malnutrition is rather chronic than acute. Also for school performance, most of children (65.9%) reported that they repeated grade because they were not smart enough, because of sickness or absenteeism.

This first study did not have the goal to demonstrate causality, but to look in the schistosomiasis' endemic community, the state of the children regarding known schistosomiasis complications. Therefore, future studies to compare communities are needed.

Since the studied factors are distributed at higher proportions, it is difficult to establish this association. For example the poverty level is general, the number of people living with household daily expenses of less than 1\$ per person (as standard used in underdeveloped countries to define poverty) was 91.8%. It is therefore difficult with this sample size, to demonstrate association. However, in this setting of Kasansa health zone, the community perception of what it means to be poor could be used to differentiate levels of poverty.

Conclusion

Beside unacceptable prevalence of pathologies like schistosomiasis and malaria, school aged children of Kasansa health zone were affected by anemia, malnutrition and low school performance. The poverty exacerbates the situation.

It is therefore important to implement other studies to demonstrate the causalities as well as to control these diseases. One option is to compare the population before and after

schistosomiasis mass treatment. If there is positive change of the above factors; we could then conclude that schistosomiasis was the cause. Another option is to compare two populations similar in all aspects except that one has schistosomiasis and the other does not; this is difficult to realize.

Preventions measures such as snail control, integrated with population drug treatment can contribute to the reduction of schistosomiasis prevalence in Kasansa health zone; however, morbidities such as anemia, malnutrition and low school performance can persist due to the recurring low-level reinfection; so the treatment may need to continue for a long period to maintain the disease control.

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