Tanzania Journal of Health Research *Volume 12, Number 4, October 2010*

SHORT COMMUNICATION

Association of intestinal helminths and *P. falciparum* infections in co-infected school children in northwest Tanzania

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Abstract: *Plasmodium falciparum malaria and intestinal helminth infections are among the most common infections in the tropics and they share the same spatial distribution. The objective of this study was to explore the association between infections with intestinal helminths and P. falciparum infection as single helminth infections or co-infections among school children. A cross-sectional study was conducted among 400 school children in Nyamtongo, Sengerema District in Tanzania. The study involved examination of single stool and finger prick blood samples for intestinal helminths and malaria parasites. A Kato-Katz technique was employed to screen for intestinal helminths and Giemsa stained thin and thick blood smears were used to screen for malaria parasites. The results of logistic regression model adjusted for age and sex indicated no association between P. falciparum and S. mansoni (OR= 0.749, 95%CI 0.418-1.344), P. falciparum and hookworm (OR= 0.885, 95%CI 0.489-1.605) and P. falciparum and co-infection of S. mansoni and hookworm (OR=0.859, 95%CI 0.422-1.745). Using multinomial regression model adjusted for age and sex, no association was observed between P. falciparum with Schistosoma mansoni [Ratio of Relative Risk (RRR) = 0.651, 95% Confidence Interval (CI) 0.331-1.363] and hookworm (RRR=0712, CI 0.280-1.765). Similarly, no association was observed between co-infections of S. mansoni + hookworm (RRR=0.635, CI 0.268-1.504) with P. falciparum infection. Co-infections of S. mansoni, hookworm and P. falciparum among school children is common in the Nyamatongo ward, Sengerema District. We recommend prospective longitudinal studies to elucidate the interactions of malaria and helminths and its health impact in risk groups.*

Keywords: malaria, schistosomiasis, hookworms, school children, Tanzania

In sub-Saharan Africa, the overlapping distribution of *P. falciparum* and helminths infections is common and resulting into high rates of co-infections (Mazigo *et al*., 2010). Co-infections of helminth and *P. falciparum* malaria may results into synergistic or antagonistic association in causing various morbidities in infected individuals (Adrienne *et al*., 2005). Co-infections of soil-transmitted helminths and *Schistosoma mansoni* are reported to increase the incidence of clinical malaria in children (Spigel *et al*., 2003). In Tanzania, concomitant occurrence of asymptomatic malaria and helminth infections have been reported in school children (Mazigo *et al*., 2010), however, reports on their association in co-infected individuals living in various epidemiological settings in Tanzania are very limited. Thus, the present study was conducted to explore the associations of *P. falciparum* malaria and helminths infections in co-infected school children living in endemic area of northwest Tanzania.

This cross-sectional study used data collected at baseline (before treatment) from 400 school children living and studying in selected schools in Nyamatongo village in Sengerema District in Tanzania. The village is located close to Lake Victoria. The study area, design, inclusion criteria and recruitment procedures have been describe elsewhere (Mazigo *et al*., 2010). At recruitment, demographic characteristics (age and sex) of the children and a finger prick blood sample were obtained and in this sample, thin and thick blood smears were prepared, stained with Giemsa and examined under the microscopy (Mazigo *et al*., 2010). Intensity of *P. falciparum* was estimated as the number of *P. falciparum* per 200 WBC (Mazigo *et al.*, 2010). A single stool sample collected from primary school by HDM in a labeled container

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was processed within an hour at a field laboratory set at school environment using Kato-Katz method (Mazigo *et al*., 2010). Two Kato-Katz slides were prepared for each sample; the slides were examined within 30 minutes for hookworm and examined the following day for other intestinal helminth (*A. lumbricoides, T. trichuris* and *S. mansoni*) by experienced parasitologists. Intensity of hookworm, *A. lumbricoides, T. trichiura* and *S. mansoni* was categorized according to WHO criteria.

Data were analysed using Stata version 11 (Stata Corp, College station, Texas, USA). The relationships between *S. mansoni*, hookworm and *S. mansoni* + hookworm with *P. falciparum* were investigated by fitting logistic regression model taking *P. falciparum* as response variable. Furthermore, co-infections analysis was investigated by fitting multinomial logistic regression model where all combination of diseases status was considered in the model (No infection, S. mansoni only, hookworm only and *S. mansoni* + hookworm). The models were adjusted for age and sex. The significance of associations of *P. falciparum* with *S. mansoni*, hookworm and co-infection of hookworm and *S. mansoni* were estimated by Odds Ratios (OR) in logistic regression model and by Ratio of Relative Risk (RRR) in multinomial logistic regression model with "no infection" used as a base. Statistical significance for all analyses was determined at *P*-value <0.05 at 95% confidence interval.

The study was approved by the Institutional Review Board (Research and Publication Committee, certificate No. BREC/001/03/2009) of the Weill-Bugando University College Health Sciences Mwanza, Tanzania. Informed written consents were obtained from children's parents or guardians and in addition assent was subsequently obtained from children.

Table 1: Multivariate logistic regression to determine the associations of* P. falciparum *malaria with helminths infections among schoolchildren in Nyamatongo, Sengerema district

	Unadjusted estimates			Adjusted estimates		
Predictors	OR	95% CI	*P*-value	OR*	95% CI	*P*-value
S. mansoni	0.769	0.432-1.368	0.371	0.749	0.418 – 1.344	0.333
Hookworm	0.892	0.495-1.607	0.704	0.885	0.489 – 1.601	0.687
S. mansoni + Hookworm	0.847	0.418-1.718	0.646	0.859	0.422 – 1.745	0.674
Sex-male	0.579	0.324-1.036	0.066	-	-	-
Age	0.989	0.858-1.140	0.884	-	-	-

OR*= adjusted for age and sex

A total of 400 schoolchildren aged 8-16 years (mean age 12.23 years) were recruited in the study between April and May 2009. The prevalence of single parasitic infection were asymptomatic *Plasmodium falciparum* 14% (n=56/400), *Schistosoma mansoni* 42.3%, (169/400) and hookworm 16%, (64/400). The prevalence of double parasitic infection was *P. falciparum* + *S. mansoni* (5.5%, 22/400), *P. falciparum* + hookworm (2.3%, 9/400) and *S. mansoni* + hookworm (22%, 88/400). For triple infection, *P. falciparum* + *S. mansoni* + hookworm was 2.8%, (88/400). *Ascaris lumbricoides* and *T. trichiura* were not recovered. No significant associations were observed between *P. falciparum*+ *S. mansoni*, *P. falciparum* + hookworm and *P. falciparum* + co-infection *S. mansoni* + hookworm (Table 1, 2).

Lack of association between hookworm infection and *P. falciparum* observed in this study have also been observed in Uganda (Shapiro *et al*., 2005). This was different from the study of Midzi *et al*., (2009) in Zimbabwe who observed strong association between hookworm and *P. falciparum*. A significant number of the children infected with *P. falciparum* were also infected with *S. mansoni*. However, no association was observed between *S. mansoni* and asymptomatic *P. falciparum*, in conflict with the results of the previous study (Midzi *et al*., 2009) but in agreement with another study from Uganda that reported no association (Shapiro *et al*., 2005). The lack of association observed in the present study can be attributed to low infection intensity of hookworm and *S. mansoni*. Only few children were observed to have high infection intensity of the two helminths. In addition, the use of single stool sample for screening of intestinal helminth, a small sample size of 400 school children, low prevalence of *P. falciparum* (13.5%), the use of single diagnostic method for intestinal parasites and malaria and the season during which the study was conducted, (April-May) at the end of long rain season may have contributed to the recovering of only few individuals with heavy infections.

Table 2: Multinomial logistic regression model to determine the associations of* P. falciparum *malaria with helminths infections among schoolchildren in Nyamatongo, Sengerema district

Disease status	Unadjusted estimates			Adjusted estimates		
	RRR	95%CI	*P*-value	RRR*	95%CI	*P*-value
S. mansoni	0.695	0.335-1.443	0.329	0.651	0.311-1.363	0.255
Hookworm	0.760	0.305-1.890	0.554	0.712	0.280 – 1.765	0.452
S. mansoni + Hookworm	0.663	0.282-1.561	0.347	0.635	0.268 – 1.504	0.302

RRR*= adjusted for age and sex

In summary, this analysis has explored the association of helminth-*P. falciparum* co-infection in primary school children. The present findings suggest no association between infection with helminth species and *P. falciparum* malaria in Nyamatongo ward, Sengerema district in contrast to observations from other studies. Taken together these findings illustrate the importance of conducting prospective longitudinal studies to elucidate the interactions of *P. falciparum* malaria and helminths and its health impact in sufficient large samples size of risk groups such as school children.

Acknowledgements

We acknowledge the valuable cooperation of parents, guardians, teachers and school children during data collection. This report is part of the master thesis for HDM in Medical Parasitology and Entomology at Institute of Tropical Medicine and Infectious Diseases, KEMRI + JKUAT, Kenya. The study received funds from Weill-Bugando University College of Health Sciences, Mwanza, Tanzania.

Conflicts of interest statement

The authors have no conflicts of interest concerning the work reported in this paper. The authors also declare that they have no financial competing interests

Received 5 July 2010
Revised 23 August 2010
Accepted 10 September 2010

References

Adrienne, E., Edridah, M., Jennifer, K., Clarkea, K., Pascal, M., Annette, O., Narcis, B., Kabatereine. & Simon, B. (2005). Epidemiology of helminth infection and their relationship to clinical malaria in Southwest Uganda. *Transactions of the Royal Society of Tropical Medicine and Hygiene* 99, 18-24.

Mazigo, H.D., Waihenya, R., Lwambo, N.J.S., Mnyone, L.L., Mahande, A.M., Seni, J., Zinga, M., Kapesa, A., Kweka, E.J., Mshana, S.E., Heukelbach, J. & Mkoji, G.M. (2010). Co-infections with *Plasmodium falciparum, Schistosoma mansoni* and intestinal helminths among school children in endemic areas of north-western Tanzania. *BMC Parasite and Vectors* 3, 44.

Midzi, N., Sangweme, D., Zinyowera, S., Mapingure, M.P., Brouwer, K.C., Munatsi, A., Mutapi, F., Mudzori, J., Kumar, W.G. & Mduluza, T. (2008). The burden of Polyparasitism among primary school children in rural and farming areas in Zimbabwe. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, 102, 1039-1045.

Shapiro, A.E., Tukulembwa, E.M., Kasten, J., Clarke, S.E., Magnussen, P., Olsen, A., Kabatereine, N.B., Ndyomugyenyi, R. & Brooker, S. (2005). Epidemiology of helminth infections and their relationship to clinical malaria in south west Uganda. *Transactions of the Royal Society of Tropical Medicine and Hygiene* 99, 18-24.

Spigel, A., Tall, A., Raphenon, G., Trape, J.F. & Druilhe, P.(2003). Increased frequency of malaria attacks in subjects co-infected by intestinal worms and *Plasmodium falciparum* malaria. *Transactions of the Royal Society of Tropical Medicine and Hyg*iene 97, 198–199.

Tanzania Journal of Health Research *Volume 12, Number 4, October 2010*

SHORT COMMUNICATION

The Aetiology, Management and clinical Outcome of Upper Gastrointestinal Bleeding among Patients Admitted at the Kilimanjaro Christian Medical Centre in Moshi, Tanzania

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***Abstract**: Upper gastro-intestinal (GI) bleeding is a life-threatening emergency that results in high morbidity and mortality and therefore requires admission to hospital for urgent diagnosis and management. The aim of this study was to determine the causes of upper GI bleeding and clinical outcome of patients admitted to medical department with the diagnosis of upper GI bleeding. A retrospective study of records of all upper GI bleeding patients who were admitted to medical department, Kilimanjaro Christian Medical Centre (KCMC) from January 2007 to December 2008 was conducted. A total of 130 patients (13-96 years old) were enrolled in the study, whereby 73 (56.2%) were males. The causes of bleeding, all endoscopically diagnosed included oesophageal varices in 55 (42.3%) cases, followed by duodenal ulcers 20 (15.4%), hemorrhagic/erosive gastritis 10 (7.7%), gastric ulcer 6 (4.6%) and Mallory Weiss tear 2 (1.5%). No cause was identified in the remaining 27 % of cases. Conservative medical therapy alone was carried out in 52.3% of the patients. Endoscopic therapy was used in 61 (46.9%) of patients. Only 2 (1.5%) patients underwent surgical intervention. The overall mortality at discharge was 17%, while 107 (82%) patients were discharged improved. In conclusion, the commonest causes of upper GI bleeding are oesophageal varices and duodenal ulcer. Most cases of upper GI bleeding were successfully treated with pharmacologic and endoscopic treatment. The high mortality may be influenced by delayed presentation to health facilities, and comorbidities. There is a need for strengthening preventive programmes and conducting studies to identify predictors of outcome of upper GI bleeding to develop evidence based management protocols.*

***Keywords:** Upper GI bleeding, aetiology, endoscopy, outcome, Tanzania*

Globally, upper gastro-intestinal (GI) bleeding continues to be a common cause of hospital admission and results in high morbidity and mortality (Cello *et al*. 1987; Longstreth 1995). Although upper GI bleeding is among the common causes of admission to many hospitals in Africa (Harries & Wirima, 1989; Kibiki *et al*., 2003; Mustapha *et al.*, 2009), epidemiological surveys from this population are limited. Previous studies in northern Tanzania showed that acute upper GI bleeding is an important cause of hospital admissions and the leading causes are oesophageal varices, oesophagitis, oesophageal ulcers, gastritis, gastric ulcers, duodenitis, duodenal ulcer, and Mallory Weiss syndrome (Kibiki *et al*., 2003). Predisposing factors for upper GI bleeding include schistosomiasis, congenital hepatic fibrosis, nodular regenerative hyperplasia, heart failures with tricuspid incompetence (which all cause portal hypertension), and peptic ulcer disease (Kumar & Clark, 2002). Endoscopy plays a pivotal role in the diagnosis and management upper GI bleeding. Nevertheless, despite the development of new therapeutic tools such as the proton pump inhibitors, endoscopic interventions and surgical approaches, the overall clinical outcome of the patients has not changed significantly and mortality rate remains around 10% (Vreeburg *et al.* 1997). There is no local data regarding the causes and clinical outcome of upper gastrointestinal tract bleeding in Tanzania. The aim of this study was therefore to fill this knowledge gap.

We retrospectively studied consecutive records of patients who were admitted to the Medical Department for upper GI bleeding and underwent diagnostic endoscopy, from January

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2007 to December 2008 at the Kilimanjaro Christian Medical Centre (KCMC). KCMC is a teaching and referral hospital located in the Moshi Municipality in northern Tanzania. It serves over 11 million people in northern Tanzania, but also many patients from central, eastern and western zones of the country.

Data on aetiology, management, and clinical outcome was collected from patient files at the Medical Records department. Information on demographic characteristics, endoscopic findings, medical and/or surgical management and condition at discharge of all patients were recorded in standardized format. Permission to conduct the study was obtained from KCMC Ethical Committee. A computer software package SPSS version 14 was used for data management and analysis. Results were summarized in frequency distribution tables, charts and figures.

A total of 130 patients were enrolled in the study. Seventy three (56.2%) were males (male to female ratio 1.2: 1). Their ages ranged from 13 to 96 years with a median age of 39 years (interquartile range: 28-53 years). Socio-demographic characteristics are summarised in Table 1.

Table 1: Socio-demographic characteristics by sex (N=130)

Characteristics	Response	No. (%) males	No. (%) females	Total
Age group (years)	≤20	3 (4.1)	4 (7)	7 (5.4)
	21-40	33 (45.2)	30 (52.6)	63 (48.5)
	41-60	24 (32.9)	12 (21.1)	36 (27.7)
	61-80	9 (12.3)	8 (14.0)	17 (13.1)
	81+	4 (5.5)	3 (5.3)	7 (5.4)
Occupation	Peasant	39 (53.4)	28 (49.1)	67 (51.5)
	Self-employed	18 (24.7)	5 (8.8)	23 (17.7)
	Employed	3 (4.1)	6 (10.5)	9 (6.9)
	Student	9 (12.3)	9 (15.8)	18 (13.9)
	Others	4 (5.5)	9 (15.8)	13 (10.0)
Residence	Kilimanjaro	55 (75.4)	41 (71.9)	96 (73.9)
	Arusha	3 (4.1)	6 (10.5)	9 (6.9)
	Manyara	4 (5.5)	1 (1.8)	5 (3.9)
	Tanga	5 (5.8)	1 (1.8)	6 (4.6)
	Others	6 (8.2)	8 (14.0)	14 (10.7)

Of the 130 patients with upper GI bleeding, in 55 it was due to oesophageal varices, 40 non-variceal causes, and in 35 patients the cause was not identified. The endoscopical grades of patients who had variceal type of upper GI bleeding were grade I, 2 (3.6%) patients, grade II 13 (23%), grade III 14 (25.5%), and grade IV 26 (47%). The frequency of non- variceal causes of upper GI bleeding were duodenal ulcer 20 (50%), haemorrhagic/erosive gastritis 10 (25%), gastric ulcer 6(15%), Mallory Weiss syndrome 2 (5%), and duodenitis 2 (5%).

Sixty two patients (47.7%) were offered conservative medical treatment only, including intravenous fluid replacement with normal saline and Ringer's lactate, intravenous proton pump inhibitors, IV octreotide, antibiotics and blood transfusion as appropriate (Figure 1). Endoscopic treatment was performed in 61 (46.9%) of patients. This included endoscopic injection of sclerosant to oesophageal varices with polidocanol and peri-lesional injection of epinephrine (1:10,000) to bleeding peptic ulcers. Only 2 (1.5%) patients were subjected to surgical intervention. Majority of patients (82%) improved clinically after treatment whereas 22 (17%) patients died, and only one (1%) had his condition worse at discharge.

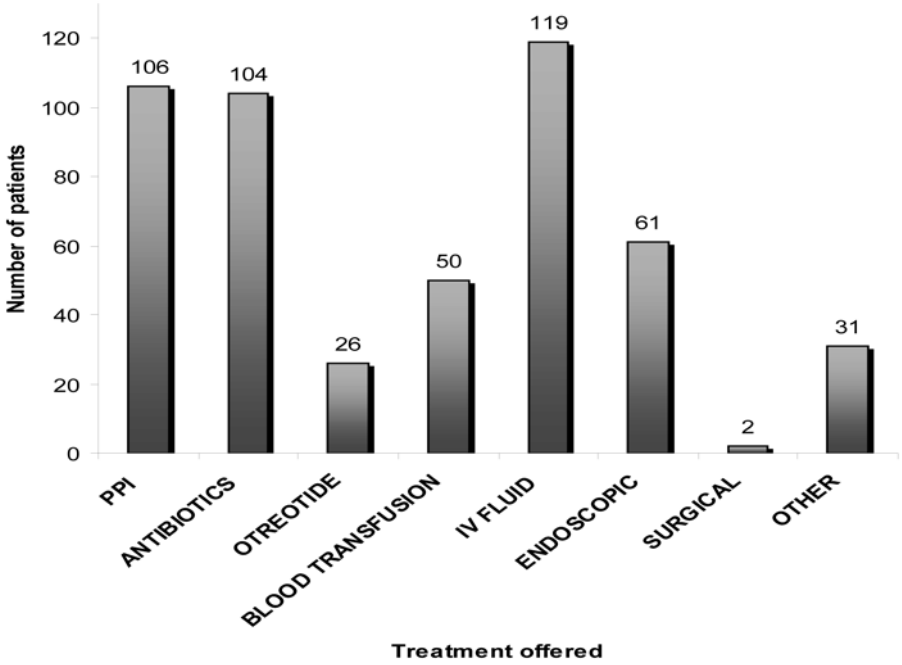

Figure 1: Treatment modalities offered

The present study was carried out at teaching hospital to obtain basic information on the socio-demographic, causes, management and clinical outcome of patients with upper GI bleeding with intent to shine light on this major cause of morbidity and mortality at our centre. Comparisons of the present retrospective study with previous studies from other cities or countries may be confounded by variations in methodology, definitions and entry criteria used as well as by the heterogeneity of the different populations analyzed. In this study, there was a slight male preponderance and this is consistent with findings of Rockall *et al*. (1995) and Yavorski *et al*. (1995). A previous study at our centre by Neema J. Rajabu (unpubl) on oesophageal varices, which is the major cause of bleeding in the present study, also showed male predominance. This might be explained by the higher prevalence of underlying illnesses among males, such as liver disease; and higher tendency of alcohol consumption among males. Majority of the study population comprised of peasants. Peasants work in environment favourable for contracting diseases like schistosomiasis which lead to portal hypertension. Similar findings were obtained in a study by Elliott (1996) in which it was found that types of activities and local production patterns determined the exposure of individuals to schistosome-infested water sources.

A bleeding site could be detected in about three-fourth of the patients in the present study. This result is similar to that reported in other studies (Rockall *et al.* 1995; Vreeburg *et al.* 1997; Zaltman *et al*. 2002). The time interval between the bleeding episode and the endoscopic procedure are known to influence the accuracy and the likelihood of finding a cause endoscopically (Zaltman *et al*. 2002). In our study, the most common bleeding lesion identified at upper endoscopy was oesophageal varices. This is consistent with findings of other studies (Harries & Wirima 1989; Kibiki *et al.* 2003) but different from studies in UK (Rockall *et al.* 1995), Netherlands (Vreeburg *et al.* 1997) and Brazil (Zaltman *et al*. 2002) where bleeding duodenal ulcer was the commonest endoscopic finding. This difference could be explained by the known high prevalence of schistosomiasis in our set up which is a known risk factor for oesophageal varices (Kitange *et al*., 1993).

In the present study, duodenal ulcer was the leading cause of non-variceal upper GI bleeding. There is definite role for *Helicobacter pylori* infection in the etiopathogenesis of duodenal ulcer (Chan *et al*. 2002). This finding could probably be due to the high prevalence of *H. pylori infection* in the population (Aoki *et al*. 2004). However, we could not determine the prevalence of the infection in this retrospective study, because tests for *H. pylori* status were not routinely made in patients with acute upper GI bleeding during the period. The overall mortality rate in the present study (17%) is consistent with studies by Zaltman *et al*. (2002) in Brazil and by Chojkier *et al*. (1986) in the USA but higher than study by (Yavorski *et al.* 1995) in the

USA. The high mortality could be due to delayed presentation to health facility and a pre-selection of high-risk patients with significant underlying medical conditions, to an academic and referral medical centre; but could also be partly compounded by comorbidities. Acute upper GI bleeding is a life threatening emergency. However, the accessibility of the patients to medical centres with experienced medical staff and adequate equipment is still limited in Tanzania. Moreover, it is possible that many patients are admitted late in the course of the bleeding episode, while others may never reach the hospital.

As it occurs in other retrospective studies, loss of data is frequent and sometimes blunts the retrieval of fundamental information. Failure to document information or loss of information in the emergency room and medical wards, as well as loss of endoscopy records resulted in lack of recorded information in several areas and serves as an advice to the need for improving the quality and consistency of recording in different units.

In conclusion, oesophageal varices is the major cause of upper GI bleeding and that upper GI bleeding is associated with high mortality. In this retrospective study we have confirmed that endoscopy contributes to identifying the bleeding site in most patients and successful treatment. There is a need for strengthening preventive programmes and conducting studies to identify predictors of outcome of upper GI bleeding to develop evidence based management protocols for subsequent reduction of the morbidity and mortality associated with the illness.

Received 12 February 2010
Revised 21 August 2010
Accepted 23 August 201

References

Aoki, K., Kihaile, P.E., Castro, M., Disla, M., Nyambo, T.B. & Misumi, J. (2004) Seroprevalences of *Helicobacter pylori* infection and Chronic Atrophic Gastritis in the United Republic of Tanzania and the Dominican Republic. *Environmental Health and Preventive Medicine* 9, 170-175.

Cello, J.P., Grendell, J.H., Crass, R.A., Weber, T.E. & Trunkey, D.D. (1987) Endoscopic sclerotherapy versus portacaval shunt in patient with severe cirrhosis and acute variceal hemorrhage. Long-term follow-up. *New England Journal of Medicine* 316, 11-15.

Chan, F.K., To, K.F., Wu, J.C., Yung, M.Y., Leung, W.K., Kwok, T., Hui, Y., Chan, H.L., Chan, C.S., Hui, E., Woo, J. & Sung, J.J. (2002) Eradication of *Helicobacter pylori* and risk of peptic ulcers in patients starting long-term treatment with non-steroidal anti-inflammatory drugs: a randomised trial. *Lancet* 359, 9-13.

Chojkier, M., Laine, L., Conn, H.O. & Lerner, E. (1986) Predictors of outcome in massive upper gastrointestinal hemorrhage. *Journal of Clinical Gastroenterology* 8, 16-22.

Elliott, D.E. (1996) Schistosomiasis. Pathophysiology, diagnosis, and treatment. *Gastroenterology Clinics of North America* 25, 599-625.

Harries, A.D. & Wirima, J.J. (1989) Upper gastrointestinal bleeding in Malawian adults and value of splenomegaly in predicting source of haemorrhage. *East African Medical Journal* 66, 97-99.

Kibiki, G.S., Hauser, M., Lyamuya, S., Lyaruu, I., Ole-Nguyaine, S. & Dolmans, W. (2003) Causes of upper gastrointestinal bleeding in Tanzania. *Tanzania Medical Journal* 18, 28.

Kitange, H.M., Swai, A.B., McLarty, D.G. & Alberti, K.G. (1993) Schistosomiasis prevalence after administration of praziquantel to school children in Melela village, Morogoro Region, Tanzania. *East African Medical Journal* 70, 782-786.

Kumar, P. & Clark, M. (2002), Clinical Medicine, fifth edition, Bath Press Limited. UK.

Mustapha, S., Ajayi, N. & Shehu, A. (2009) Aetiology of upper gastrointestinal bleeding in north-eastern Nigeria: A retrospective endoscopic study. *The Internet Journal of Third World Medicine* 8.

Rockall, T.A., Logan, R.F., Devlin, H.B. & Northfield, T.C. (1995) Incidence of and mortality from acute upper gastrointestinal haemorrhage in the United Kingdom. Steering Committee and Members of the National Audit of Acute Upper Gastrointestinal Haemorrhage. *BMJ* 311, 222-226.

Vreeburg, E.M., Snel, P., de Bruijne, J.W., Bartelsman, J.F., Rauws, E.A. & Tytgat, G.N. (1997) Acute upper gastrointestinal bleeding in the Amsterdam area: incidence, diagnosis, and clinical outcome. *American Journal of Gastroenterology* 92, 236-243.

Yavorski, R.T., Wong, R.K., Maydonovitch, C.,

Battin, L.S., Furnia, A. & Amundson, D.E. (1995) Analysis of 3,294 cases of upper gastrointestinal bleeding in military medical facilities. *American Journal of Gastroenterology* 90, 568-573.

Zaltman, C., Souza, H.S., Castro, M.E., Sobral, M.F., Dias, P.C. & Lemos, V., Jr. (2002). Upper gastrointestinal bleeding in a Brazilian hospital: a retrospective study of endoscopic records. *Arquivos de Gastroenterologia* 39, 74-80.