Risk factors for the transmission of kala-azar in Fangak, South Sudan

John Lagu Nyungura[a], Venny C.S Nyambati[b], Mugo Muita[c] and Eric Muchiri[d]

Abstract

This article reports a case controlled study of kala-azar done in Fangak County in 2007. Fifty-six percent of the cases were under 5 years old. Most patients came for treatment two months or more after the onset of symptoms.

Outdoor night-time activities and the use of "smoking" (non-insecticide treated) bed nets were associated with kala-azar infection whereas the use of bed nets during the rainy season decreased the risk of infection.

It is recommended that there should be a greater distribution of treated bed nets and more kala-azar treatment centres in the county.

Note: This article reports the results of a study into some risk factors for the transmission of kala-azar in Fangak in 2007. There was another recent outbreak in this area on 2010 (1, 2). Recommendations were again made to distribute more treated bed nets and to open more kala-azar treatment centres. The official Ministry of Health guideline for the treatment of kala-azar is at the end of this article.

Introduction

Leishmaniases are caused by 20 species of *Leishmania (L)* and transmitted by 30 species of sandfly (3). The sandfly bites humans at night, primarily at twilight. Ninety percent of kala-azar/visceral leishmaniasis cases occur in Bangladesh, India, Nepal, Sudan and Brazil (4). Kala-azar is caused by *L. donovani* complex, which includes *L. donovani, L. infantum* and *L. chagasi*. It is characterised by:

- prolonged irregular fever
- lymphadenopathy
- hepato-splenomegaly and
- progressive anaemia (5).

The disease kills almost all untreated patients (6).

The endemic belt in the Sudan stretches from the Atbara River in the north-east to the Southern Sudan, Nuba Mountains and Darfur (7). *Phlebotomus orientalis* is the vector transmitting kala-azar in Sudan and is associated with black cotton soils and vegetations of *Acacia seyal* and *Balanites aegyptiaca* (8). However, in Kapoeta *P. martini may* be the vector (9).

a Ministry of Health, Government of Southern Sudan
jlagu2001@yahoo.com
b Department of Biochemistry, Jomo Kenyatta University of Agriculture and Technology, Nairobi, Kenya
c Resident Advisor, Field Epidemiology and Laboratory Training Program, Southern Sudan
d Field Epidemiology and Laboratory Training Program Nairobi, Kenya

Materials and methods

An unmatched case control study was carried out in Fangak County from October to December 2007. Questionnaires drafted in English were translated orally into the Nuer language. Exposure histories were taken retrospectively for the past year. This study was managed at the Coordinating Committee of the Organization for Voluntary Service (COSV) at a primary health care centre (PHCC).

The target population was kala-azar patients aged above two months old who had been living in Fangak County for at least two months and who presented for medical care. The sample size was calculated using statcalc in *Epi*

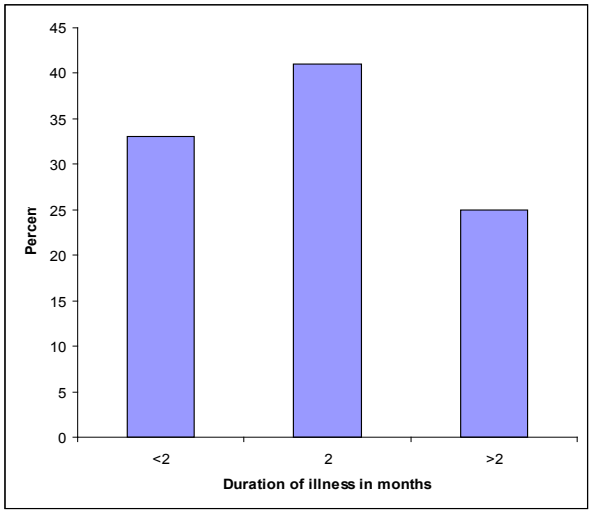

Figure 1. Distribution of patients by duration of illness before starting treatment

Info 3.3.2 software. The following was employed: ratio of controls to cases, 2:1; power of 80%; confidence interval level of 95%. A sample size of 144 was obtained.

Two health facility controls that tested negative by dipstick were randomly selected for each case identified. Relatives of kala-azar patients were excluded as controls. Data were entered into the computer using Epi Info version 3.3.2 and kept confidential. Univariate, bivariate and unconditional logistic regression analyses were performed.

Results

There were 144 study recruits, 48 (33%) were cases and 96 (67%) were controls. Among the cases, 21 (44%) were males and 27 were females. Twenty-seven (56%) of all cases were under five years old (see Table 1) and 24 (89%) of these were under three years old.

Thirty-seven (77%) kala-azar patients presented for treatment at two months or more after the onset of symptoms (see Figure 1). Often traditional treatment is tried first. Figure 2 shows a child who has been treated with facial tattoos. Figure 3 is a child with kala-azar seen during the 2010 outbreak.

All cases of kala-azar had fever and enlarged lymph nodes (lymphadenopathy), 46% had an enlarged spleen (splenomegaly) and 42% an enlarged liver (hepatomegaly). Table 2 shows the number of cases and controls sleeping under different types of bed nets. Only 4 cases and 2 controls did not use a bed net. 69% of both cases and controls used bed nets purchased by the family.

Table 3 shows that the use of the "Smoking" type of bed nets was statistically significantly associated with kala-azar infection, while consistent use of a bed net during the rainy season (May to October 2007) was protective against kala-azar.

Note: The "Dhamoria" and the "Smoking" are types of non-insecticide treated bed nets. "Smoking" bed nets are made of green silky fibre in Khartoum. "Smoking" clothes are a favourite garment for Sudanese women who cover themselves with smoking from head to toes. People in Fangak prefer this type of bed net because it gives privacy outside during the hot season (see Figure 4)

Of the environmental factors analysed in Table 4, outdoor night activities were associated with kala-azar infection (p = 0.02). There was a "tendency towards significance"/borderline association when anthills (p = 0.07) and *B. aegytiaca* were near homes. When these factors were subjected to multiple logistic regression analysis, only outdoor night activities retained statistical significance (p = 0.01) (see Table 5).

Table 1. Distribution of cases and controls by age

	Cases: n (%)	Controls: n (%)
Total	48	96
Age in years		
0 - 5	27 (56)	60 (63)
5 - 10	10 (21)	8 (8)
10 - 15	2 (4)	4 (4)
15 - 20	3 (6)	4 (4)
20 - 25	3 (6)	4 (4)
>25	3 (6)	16 (17)
Age range	9 mo-45 yrs	5 mo-62 yrs

Figure 2. Attempt to treat kala-azar using traditional treatment (facial tattoos).

Table 2. Bed net use by cases and controls

	Cases: n (%)	Controls: n (%)
Types of bednets use		
Uses no bed net	4 (8)	2 (2)
Family purchased bed net	33 (69)	66 (69)
Types of bed nets		
"Polyethylene" ITNs	0 (0)	24 (25)
"Dhamoria" non ITNs	24 (50)	46 (48)
"Smoking" non ITNs	20 (42)	24 (25)
Total using any type of bed net	44 (92)	94 (98)

Table 3. Multiple logistic regression analysis for bed net use and the occurrence of kala-azar infection

Variable	OR	(95% C.I.)	P- value
Always uses bed net in rainy season	0.33	(0.15-0.72)	0.01
Uses "Smoking" type of bed nets	2.55	(1.14-5.71)	0.02

Figure 3. Patient with kala-azar seen during the 2010 outbreak at Fangar. He is visibly wasted and has an enlarged abdomen (splenomegaly).

Discussion

More than half of the participants affected by kala-azar were children aged less than five years. The greater susceptibility of the young children in the Fangak study could be due to malnutrition and an immature immune system. Lack of knowledge on kala-azar treatment by the family may have contributed to patients coming late for treatment.

This study indicated the following statistically significant associations:

- Engaging in night-time activities (e.g. dancing and games) increases the risk of kala-azar infection.
- A person is two and half times more likely to be at risk of getting kala-azar using a "Smoking" bed net than a treated bed net. The reason for this is not clear. However the "Smoking" type of bed nets are made of light silk fibre so are easily blown away by the wind while the person is sleeping.
- The regular use of a bed net during the rainy seasons provides a degree of protection from kala-azar - a finding similar to that in a study from Bangladesh (10).

Although it was reported that almost everyone slept under a bed net, most used non-insecticide treated bed nets. It was reported that among the kala-azar cases nobody was sleeping under an insecticide-treated bed net; 42% of cases were using "Smoking" bed nets compared with 25% of the controls.

Further analyses are needed to clarify the associations between kala-azar and other types of non-treated bed nets, and whether people using "Smoking" bed nets are more likely than others to be involved with night-time activities. It is hoped to publish these results later.

The authors recommend increased distribution of treated bed nets and the expansion of kala-azar treatment centres in the county.

References

1. Murthi H. Upsurge of kala-azar cases in Southern Sudan requires rapid response. WHO 2010 at http://www.who.int/leishmaniasis/Upsurge_kalaazar_Southern_Sudan.pdf
2. Médecins Sans Frontières. Southern Sudan in grips of worst disease outbreak in eight years. http://www.doctorswithoutborders.org/press/release.cfm?id=4924&cat=press-release 2010
3. Desjeux P. (1992). Human leishmaniasis: epidemiology and Public health aspects. *Wrld Hlth Stat Q*. 45; 267-75
4. WHO. 2002. Available at www.who.int/tdrold/diseases/leish/diseaseinfo.htm
5. Agrawal S, Rai M and Sundar S. Management of visceral

Table 4. Bivariate analysis for environmental factors

Variables	OR	(95%C.I.)	P-value
Keep sleeping on damp/wet floor	1.30	(0.64-2.64)	0.47
Cracks inside or outside sleeping house	1.20	(0.61-2.51)	0.55
Sleeping house less than 100m from the river/stagnant water source	1.34	(0.67-2.69)	0.41
House near an anthill	1.89	(0.94-3.80)	0.07
House near *Acacia seyal* (Seb or Luor)	0.84	(0.41-1.72)	0.63
House near *Balanites aegyptiaca* (Thaou)	1.90	(0.93-3.88)	0.08
House near *Azadiracta indica* (Neem)	0.72	(0.35-1.52)	0.39
Occasionally play in the dark in the forest or around houses	2.36	(1.16-4.80)	0.02

TREATMENT OF KALA-AZAR

The official guideline adopted by the Ministry of Health is:

1. Sodium stibogluconate (20mg/kg)/day and paromomycin (15 mg/kg)/day for 17 days
2. Sodium stibogluconate 20mg/kg/day for 30 days
3. Liposomal amphotericin 3-5mg/kg/day infusion for over 6-10 days up to a total of 30mg/kg
4. Amphotericin B deoxycholate 0.75-1 mg/kg/day by infusion daily or on alternate days for 15-20 doses
5. Miltefosine orally at 2.5 mg/kg/day for 28 days

NB: The first three are the medicines currently in use in South Sudan.

Table 5. Multiple logistic regression analysis

Environmental variables	OR	(95% C.I.)	P- value
B. aegyptiaca in the compound	1.90	0.93-3.88	0.08
Ant hills near home	1.88	0.94-3.80	3.80
Often spends time in night time activities (traditional dances and children games)	2.59	(1.20-5.57)	0.01

leishmaniasis: Indian perspective. *J Post grad Med.* 2005 51; 53-57

6. Boelaert M, Criel B, Leeuwenburg J, Damme van W, Le Ray D and Van der Stuvft P. *Visceral leishmaniasis* control: A public health perspective. *Trans R Soc Trop Med Hyg.* 2000. 94; 465–471
7. Osman OF, Kager PA and Oskam *L. Leishmaniasis* in the Sudan: a literature review with emphasis on clinical aspects. *Am J Trop Med Hyg.* 2000. 18; 1091-1210
8. Quate LW. Phlebotomus sandflies of the Paloich Area in the Sudan (Diptera, Psychodidae). *J Med Ento mol.* 1964 1; 213-268
9. Minter DM, Wijers DJB, Heisch RB and Manson-Bahr PEC. Phlebotomus martini, a probable vector of kala-azar in Kenya. *Br Med J.* 1962. 2; 835
10. Caryn B, Allen WH et al, Risk Factors for Kala-azar in Bangladesh. *Emerg Infect Dis* 2005 May. Available at http://www.cdc.gov/ncidod/EID/vol11no05/04-0718.htm

Figure 4. Types of bed nets in use (Smoking on left and Dhamoria on right).

Further reading

- Kolaczinski J, Hope A, Rumunu J, Richer M, Ruiz JA & Seaman J. Kala-azar Epidemiology and Control, Southern Sudan. *Emerging Infectious Diseases* 2008. 14: 664-666. http://www.malariaconsortium.org/pages/ntd_resources.htm

All photographs by John Lagu

SUDAN MEDICAL COUNCIL STARTS WORK IN JUBA

The Sudan Medical Council, Southern Sudan branch has opened in Juba and is temporarily housed at the Ministry of Health, Ministerial Complex Juba. Therefore all medical and allied health professionals delivering health services in Southern Sudan are required to be registered and to legalise their practices with immediate effect. The health professionals include Specialists, Consultants, Doctors, Medical Assistants, Clinical Officers, Dentists, Dental Technicians, Nurses, Midwifes, Pharmacists, Laboratory Technologists, Technicians, etc.

For more information and conditions of eligibility for registration, see the notice board at the Medical Council office at the Ministry of Health, Juba or email: ssmedicalcouncil@gmail.com. More information may be found on the SSMJ website.

SSMJ would like to thank the authors of articles and everyone else who helped to prepare this issue including Charles Bakheit, John Adwok, Stanley Mwase and Ruth Parent.