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The poorest of the poor: a poverty appraisal of households affected by visceral leishmaniasis in Bihar, India

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Summary

OBJECTIVE To provide data about wealth distribution in visceral leishmanisis (VL)-affected communities compared to that of the general population of Bihar State, India.

METHODS After extensive disease risk mapping, 16 clusters with high VL transmission were selected in Bihar. An exhaustive census of all households in the clusters was conducted and socio-economic household characteristics were documented by questionnaire. Data on the general Bihar population taken from the National Family Health Survey of India were used for comparison. An asset index was developed based on Principal Components Analysis and the distribution of this asset index for the VL communities was compared with that of the general population of Bihar.

RESULTS 83% of households in communities with high VL attack rates belonged to the two lowest quintiles of the Bihar wealth distribution. All socio-economic indicators showed significantly lower wealth for those households.

CONCLUSION Visceral leishmanisis clearly affects the poorest of the poor in India. They are most vulnerable, as this vector-born disease is linked to poor housing and unhealthy habitats. The disease leads the affected households to more destitution because of its impact on household income and wealth. Support for the present VL elimination initiative is important in the fight against poverty.

keywords visceral leishmaniasis, poverty, vulnerability, wealth distribution, Bihar

Introduction

Visceral leishmaniasis (VL) or kala-azar is a parasitic disease affecting an estimated 500 000 new cases per year, mostly in the Indian subcontinent and East Africa, though this figure is subject to substantial uncertainty. VL usually occurs in small clusters in remote areas with poor access to health services and exact case numbers are poorly documented. In prospective studies of such clusters in East-Africa, incidence rates of VL varied between 2/1000–40/1000 person-years (Ali & Ashford 1994; Zijlstra *et al.* 1994; Schaefer *et al.* 1995). Incidence rates reported from the Indian subcontinent in 2001–2003 were in similar ranges (Singh *et al.* 2006). These rates are comparable to or higher than the incidence rates of tuberculosis at community level, but cannot be extrapolated to the population at large beyond the boundaries of the clusters where active VL transmission occurs, whereas tuberculosis is more homogeneously distributed. Nonetheless, VL can have a disastrous impact when an epidemic strikes a non-immune population. In famine-affected Southern Sudan, a VL epidemic caused the death of an estimated 100 000 people between 1984 and 1994 in Western Upper Nile Province (Seaman *et al.* 1996).

Visceral leishmaniasis is nowadays considered as one of the 'most neglected diseases', a term coined to highlight the lack of innovation in both its clinical management and control (Trouiller *et al.* 2001). Several authors also concur that VL is a poverty-related disease, though the importance of VL as a hindrance for economic development is still not fully recognized (Wijeyaratne *et al.* 1994).

Advocates for the control of the disease will often claim that VL disproportionally affects 'the poorest of the poor' (Alvar *et al.* 2006), but this statement was not substantiated so far, apart from showing that VL patients live below the poverty line (Desjeux 1996), but so do many of their non-affected fellow citizens. In the context of a community intervention trial on the effect of long-lasting impregnated bed nets in the prevention of VL conducted in Bihar, India

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(the KALANET trial, see http://www.kalanetproject.org), we studied the socio-economic profile of the households living in areas with high VL endemicity and compared it to that of the general population of Bihar.

Methods

Study area

Within the framework of the KALANET community intervention trial (Clinicaltrials.gov CT-2005-015374), we started in February 2006 to identify eligible VL clusters (i.e. well-defined communities with 350–1500 inhabitants) with a high incidence of VL in Muzaffarpur district (3.7 million inhabitants) in the northern part of Bihar State, India. Preliminary information about villages with large numbers of VL cases was obtained from the public health system (Primary Health Centers, District Hospital and Medical College) and private and charitable hospitals. By the end of March 2006, we had identified 35 clusters with the highest reported number of VL cases in Muzaffarpur district. This was followed by a house to house survey of these clusters in May 2006 to evaluate the incidence rate of VL during the preceding three years (3.5 years in some clusters; 2003–2005/06). From these, 16 study clusters were selected (Table 1), based on five characteristics: (i) Reporting VL cases in each year of the 3-year-period, thus showing continuous transmission of the disease; (ii) an average of at least 0.8% VL incidence rate over the past 3 or 3.5 years; (iii) highest incidence rates; (iv) population between 350 and 1500; (v) minimum distance between any two clusters of 1 km.

Socio-economic data

In the 16 study clusters, extensive household (HH) and individual data were collected in August–September 2006 on pre-designed questionnaires that included standardized questions on socio-economic items in an exhaustive census of the households. Information was collected from 2013 households and double-entered into an Access database.

As comparison data, we used data from the third National Family Health Survey (NFHS-3) of India (authorized on 26/11/2007) to document the socio-economic status of the households in the state of Bihar, to which the above clusters belonged. The Indian NFHS are nationwide surveys conducted with a representative sample of households throughout the country, which provide data on population and health indicators such as fertility, family planning, infant and child mortality, maternal and child health, nutrition or morbidity and health care. These surveys are implemented by the International Institute for Population Sciences of Mumbai, and belong to the Monitoring and Evaluation to Assess and Use Results (MEASURE), Demographic and Health Surveys (DHS) project, composed of several partners who provide technical assistance and funding to more than 200 surveys in 75 countries since 1984. The Indian NFHS-3 was conducted between November 2005 and August 2006, with an overall sample size of 109 041 households (International

Table 1 Selected clusters with high visceral leishmanisis (VL) incidence in Muzaffarpur district, Bihar

Cluster	Population	VL incidence			Annual incidence rate per 100 person/years
		2003	2004	2005/2006*	
1*	779	20	1	6	0.99
2	1210	7	12	27	1.27
3	716	6	9	5	0.93
4	601	6	6	9	1.16
5*	605	6	7	11	1.13
6	517	2	8	11	1.35
7*	648	6	3	37	2.02
8	630	7	8	12	1.43
9*	850	1	4	31	1.21
10*	559	6	10	24	2.04
11	464	11	2	4	1.22
12*	728	5	10	21	1.41
13*	459	5	6	11	1.37
14*	1150	11	13	32	1.39
15	350	8	5	4	1.62
16*	1051	4	15	65	2.28

*Figure represents incidence calculated over 3.5 years; these are clusters where the number of VL cases during the first 6 months in 2006 was also collected.

Institute for Population Sciences & Macro International 2007) and 2997 households from the state of Bihar. We used the latter data.

Asset index

To allow poverty ranking of the Bihar as well as the households living in areas with a high VL endemicity, we chose an approach based on an asset index, which has been widely used as a proxy to measure poverty when income and expenditure data are of poor quality or not available. Data on ownership of durable assets in the households, characteristics of the habitat and access to basic services are the indicators most commonly collected and used to construct a single 'asset index'. This measure reflects the long-run household wealth or living standard, so unequal measures of the asset index can be considered as proxies for inequalities in long-run wealth (Filmer & Pritchett 2001; Falkingham & Namazie 2002; McKenzie 2005). We selected nine indicators, reflecting four dimensions of long-run wealth, to be included in the asset index (Table 2).

We used Principal Components Analysis (PCA) to aggregate the information from the different indicators in order to create an asset index that explained 35.4% of variance. The analysis was performed with SPSS v.15.0 software. PCA is a multivariate statistical technique that assigns weights to the indicators so to create the weighted linear combination of the variables that accounts for the largest amount of the total variation in the data (Kleinbaum *et al.* 1988; Vyas & Kumaranayake 2006). PCA has been applied by several authors to create indices of relative poverty (Filmer & Pritchett 2001; McKenzie 2005; Vyas & Kumaranayake 2006; Zeller *et al.* 2006; Morris *et al.* 2007) with the underlying assumption that relative poverty explains the maximum variance in the variables.

Table 2 Indicators included in the asset index

Category	Asset indicator
Housing structure	Type of house: Kachha; Semi-pucca; Pucca
Household access to utilities and infrastructure	Main type of fuel used for cooking : traditional (animal dung/agricultural crop waste/straw, shrubs, grass) or modern (gas, electricity or petrol)
	Whether the household has electricity or not
Productive assets	Whether the household has a bicycle or not
	Whether the household has a motorcycle/scooter or not
	Whether the household has a car/tractor or not
Non productive assets	Whether the household has a radio or not
	Whether the household has a television or not
	Whether the household has a cot/bed or not

When the indicators included in the PCA differ in their measurement scale, they should be converted into standardized variables, so that the resulting index can be represented by the formula:

$$A_i = f_1 \frac{(a_{i1} - \overline{a_1})}{s_1} + \cdots + f_n \frac{(a_{in} - \overline{a_n})}{s_n}$$

where A_i is the asset index of the i^{th} household, f_1 is the weight for the first indicator, a_{i1} is the i^{th} household's value for the first indicator and $\bar{a}_1$and s_1 are the mean and standard deviation of the first indicator over all households (Filmer & Pritchett 2001).

We used the asset index score to classify the households from Bihar state in wealth quintiles. Using the formula mentioned above, we applied the weights obtained with PCA to the indicator values of the households living in areas with a high VL endemicity (KALANET project clusters), in order to place them within the wealth quintiles of the state of Bihar. Student's *t*-test was used to compare asset ownership between Bihar and highly endemic VL clusters.

Ethical approval

The study was conducted as part of the KALANET community intervention trial (Clinicaltrials.gov CT-2005-015374), for which ethical clearance was obtained from the Institutional Review Boards at Banaras Hindu University and the Institute of Tropical Medicine.

Results

The distribution of the asset index score for the general population of the State of Bihar is shown in Figure 1. The asset index is a measure of relative poverty, so the lower the score, the poorer the household relative to all others with higher scores. Figure 2 shows how households from highly endemic VL areas fit within the wealth distribution of the households in Bihar based on NFHS-3 data. The number of households in the top two quintiles (8.3%) is very low, and the vast majority of households in VL endemic areas are situated in the two poorest quintiles of the wealth distribution of Bihar (83.3%).

Table 3 shows the distribution of the socio-economic indicators included in the asset index for the Bihar and the populations living in areas with a high VL endemicity. There are significant differences between both populations in all the indicators, pointing out the extremely low

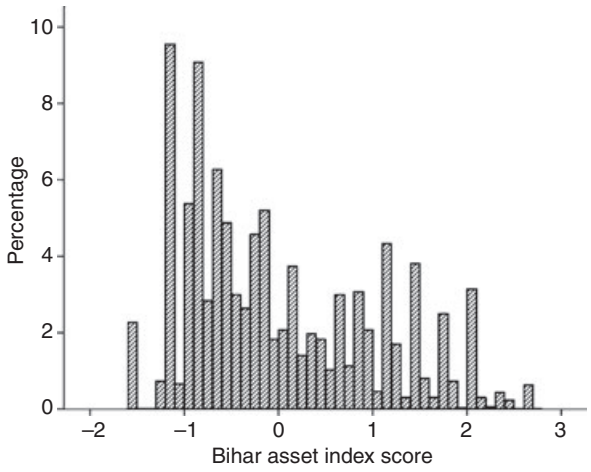

Figure 1 Histogram of the Bihar Asset Index.

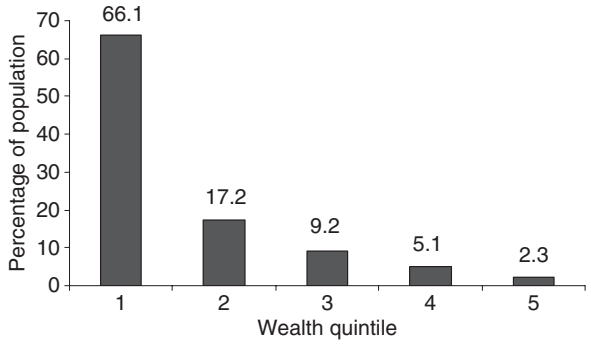

Figure 2 Distribution of wealth of households living in highly endemic visceral leishmanisis (VL) clusters within the socio-economic quintiles of all Bihar households.

numbers of households with appropriate housing and access to basic services and assets in the communities affected by kala-azar.

Other socio-economic indicators (not included in the asset index) such as education, caste or religion of the head of the household also show significant differences (Table 4). Higher percentages of illiteracy are found amongst the heads of the households living in areas with a high VL endemicity. There was a stronger presence of Scheduled Castes (SC), Scheduled Tribes (ST) and Other Backward Castes (OBC), the lower castes in India, in the clusters affected by high VL transmission.

Discussion

This study is the first to show clearly that VL affects the poorest of the poor. Bihar state is known to be one of the poorer states of India, with 40% of its population living below the poverty line, while the national average is 29% (World Bank 2008). Our data indicate that the communities with high and active VL transmission over the past three years are situated at the lower end of the wealth distribution of Bihar state.

The fact that data from two different surveys were used to construct the asset index can be considered a limitation, though both were carried out contemporaneously and worked with an almost similar set of standard questions. PCA was used to derive the weights assigned to the assets included in the index. Filmer and Pritchett (2001) showed that a PCA-based index performed as well as

Table 3 Socio-economic indicators for Bihar and highly endemic visceral leishmanisis (VL) cluster populations

Asset indicator	Bihar *n* (%)	Highly endemic VL cluster *n* (%)	*P*-value
Type of house			
Kachha	794 (26.5)	1418 (70.4)	<0.0001
Semi-Pucca	1248 (41.6)	477 (23.7)	<0.0001
Pucca	955 (31.9)	118 (5.9)	<0.0001
Traditional* cooking fuel	1639 (54.7)	1845 (91.7)	<0.0001
Electricity	1212 (40.4)	193 (9.6)	<0.0001
Bicycle	1646 (54.9)	839 (41.7)	<0.0001
Motorcycle/scooter	338 (11.3)	46 (2.3)	<0.0001
Car/tractor	96 (3.2)	10 (0.5)	<0.0001
Radio	983 (32.8)	197 (9.8)	<0.0001
Television	864 (28.8)	136 (6.8)	<0.0001
Cot/bed	2722 (90.8)	1556 (77.3)	<0.0001
Total	2997 (100.0)	2013 (100.0)	

*Traditional = Animal dung, agricultural crop waste, straw, shrubs or grass.

Table 4 Socio-economic characteristics of heads of households

Variable	Bihar *n* (%)	Highly endemic VL cluster *n* (%)	*P*-value
Caste*			
SC/ST	503 (16.8)	440 (21.9)	<0.0001
OBC	1792 (59.8)	1381 (68.6)	<0.0001
Other	697 (23.3)	175 (8.7)	<0.0001
Illiterate	1588 (53.0)	1354 (67.3)	<0.0001
Religion			
Hindu	2477 (82.6)	1801 (89.5)	<0.0001
Muslim	513 (17.1)	212 (10.5)	<0.0001
Total	2997 (100.0)	2013 (100.0)	

*SC/ST: scheduled caste/scheduled tribe; OBC: other backward caste.

consumption expenditure, and more recently a study comparing different methods to assign weights to the indicators concluded that PCA was a suitable method (Howe *et al.* 2008) although the weighing method might be of less importance than the data used.

There exists ample evidence that poverty and ill-health are intertwined, with poor people suffering worse health and having more limited access to health care. Likewise, ill-health may lead to a loss of income through absence from work and high health care costs (Wagstaff 2002), driving poor households even further into poverty (Bloom & Canning 2003). As described by Alvar *et al.* (2006), the relationship of VL to poverty is complex and additional research that leads to a better understanding on the interaction between VL and poverty is needed. In the Indian subcontinent, infection risk is clearly related to poor housing conditions and sanitation, as the sand fly vector *Phlebotomus argentipes* breeds in cracks of mud-plastered houses and moist soils. The disease has a chronic course and is fatal if left untreated; therefore households often sell their assets and take loans to pay for health care and expensive drugs which may result in significant impoverishment (Desjeux 1996). Moreover in every family with a VL case, the severely debilitating disease has a significant impact on earnings and consumption with many days of productive life lost due to illness. Two studies from Nepal and a study from India showed how the total cost of a VL episode to affected families exceeded their average annual per capita income and how households either sold part of their livestock or took loans to cover the costs (Adhikari & Maskay 2003; Rijal *et al.* 2006; Meheus *et al.* 2006).

Although our results have shown that in Bihar communities with high VL incidence are considerably poorer than the rest of the state, this does not necessarily imply a causal relationship between VL and poverty. Wealth differences between VL affected clusters and the rest of Bihar could also be explained by other factors such as differences in ecological conditions and economic growth within Bihar or individual differences such as caste, literacy rates and land ownership. Comparing VL endemic clusters with for example North Bihar only, which would have taken into account regional wealth differences to a certain extent, was not possible since the NFHS-3 does not include district level identifiers for reasons of confidentiality (the survey also measures HIV-status). Even so, this does not alter the findings presented in this paper.

Though global case numbers of VL might rank lower than those of HIV/AIDS, malaria and tuberculosis, the social and economic implications of VL in affected communities are profound. VL clearly affects the poorest of the poor in India and adds to their destitution. This study suggests that current and future preventive measures for such a deadly disease need to be subsidized or provided free to the majority of households living in VL affected areas of India, or else they might prove futile. Support for the present VL elimination initiative is important in the fight against poverty.

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