Short Report: Estimation of Under-Reporting of Visceral Leishmaniasis Cases in Bihar, India

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Abstract. We estimated the level of under-reporting of visceral leishmaniasis (VL) cases by comparing the actual reported cases with those expected as estimated using age- and sex-stratified incidence proportions obtained in a cohort of 31,324 persons. The average incidence proportion of VL cases in study population was 5.7/1,000 (95% confidence interval [CI] = 4.88–6.54) and 1.09/1,000 persons (95% CI = 0.99–1.20) based on the reported cases in two primary health centers. The overall magnitude of VL cases not reported to the government agencies was higher by a factor 4.17 (95% CI = 3.75–4.63) than for reported cases. The levels of under-reporting were 4.74 (95% CI = 4.11–5.47) in males and 3.51 (95% CI = 2.99–4.11) in females with no significant difference ($P > 0.05$). It was significantly higher in persons ≥ 30 years of age than in persons 30 years of age ($P < 0.05$).

Visceral leishmaniasis (VL) or Indian kala-azar is a parasitic disease caused by *Leishmania donovani* and transmitted through bites of the sand fly *Phlebotomus argentipes*.¹ More than 90% of VL cases occur in India, Bangladesh, Nepal, Brazil, and Sudan.^{2,3} Leishmaniasis in different forms is endemic in 88 countries in 4 continents, and 200 million persons globally are at risk for this disease.⁴ It is one of the major health problems in Bihar and adjoining areas of West Bengal, Jharkhand, and Uttar Pradesh in India; there are focal and sporadic cases in 50–52 districts for many decades.^{5,6} Currently, 30 of 38 districts in Bihar have different levels of endemicity, and nearly 67.5 million persons are at the risk for the disease. An average of more than 90% of VL cases in India are reported from Bihar alone.⁵

There is no current active surveillance mechanism for proper reporting of VL in the affected areas, which leads to serious under-reporting of VL cases. It has been reported that the total number of estimated cases could be 2–2.5 times higher than the actual incidence and may be even 5 times higher than the officially reported figures.^{5,7} In the absence of accurate statistics, it is difficult for health planners and policy makers to evolve a suitable control strategy for elimination of VL by the year 2015 from the Indian subcontinent.⁸

Many studies have been conducted for estimating the extent of under-reporting of VL cases in different areas in Bihar in which VL is endemic.^{1,9–11} These studies were based on the total cases reported in the source population or observed in the study population, without stratifying for age and sex variables. Thus, these studies estimated only the crude incidence proportion (risk) or rate. Taking these facts into account, we conducted a study with the objective to estimate the level of under-reporting of VL cases in the total population and stratified by age and sex.

Two public health centers in an area in which VL is endemic (Lalganj and Goraul in the Vaishali District) were selected on the basis of passive VL case reporting in past five years. These two public health centers had estimated populations of 412,035 and 235,730, respectively, in 2006 determined by an

exponential growth rate equation and a population growth rate of 2.98%.¹² The age-sex specific initial population and exponential growth rate were taken from Census 2001 of the Vaishali District.

Records of VL cases identified, treated, and reported in public health centers, district hospitals, and medical college hospitals during 2006 were collected. Complete information such as name, age, sex, father/husband name (use as an identifier in villages), village name, months of reporting, and treatment taken were compiled for each VL cases by using Epi-Info 2000, version 3.2.2 (Centers for Disease Control and Prevention, Atlanta, GA).

A house-to-house survey was conducted in the study population (a cohort of 31,324 persons based on sample size) living in 17 villages. These villages were selected randomly from a sampling frame of the affected villages in two public health centers. Information on incidence of VL during January–December 2006 was collected retrospectively by field workers using a semi-structured questionnaire from March 2007 to the middle of June 2007. Data were collected on demographic characteristics of family members, past medical history, occurrence of VL, date and place of reporting, and treatment taken. Cases of VL were verified through documents such as patient cards, prescriptions, test reports and drugs received.

Informed verbal consent was obtained from all respondents before collecting the information. The study was reviewed and approved by the ethical committee of Rajendra Memorial Institute of Medical Sciences, Indian Council of Medical Research, Patna.

Data collected from both source populations (two public health centers) and study population (cohort of 31,324 persons) were stratified on age and sex. We estimated the age- and sex-stratified incidence proportion per 1,000 persons with 95% confidence intervals (CIs) using standard formulas.¹³ A direct standardization method was used for estimating expected number of VL cases in the source population using age- and sex-stratified populations of two public health centers as standards and age- and sex-stratified incidence proportions observed in the study population. When we compared the numbers of reported and estimated total VL cases in source population, we estimated age- and sex-stratified ratios of unreported to reported VL cases.

A total of 425 new VL cases were reported to the two public health centers, which had a combined population of 388,659

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persons at risk in 135 villages. In the household survey, 177 VL cases were detected during the reference period. Of 177 patients with VL, 16 died during the reporting period, 52 (29.4%) were diagnosed and treated at nearest public health facilities, and 125 (70.6%) were diagnosed and treated at private clinics.

The age and sex distribution of the incidence proportion of VL per 1,000 persons and ratios of unreported to reported VL cases with 95% CIs in the study and source populations are shown in (Table 1). In the source population, the overall incidence proportion was 1.09 cases of VL/1,000 persons (95% CI = 0.99–1.20), which indicated no sex-specific significant difference ($P > 0.05$). We observed significantly higher incidence or risk of VL in persons 5–14 and 15–29 years of age than in the other age groups ($P < 0.05$). The incidence or risk was low among the children less than four years of age, and risk decreased with age.

In study population, the overall incidence proportion was 5.7 cases of VL/1,000 persons (95% CI = 4.88–6.54), which indicated no significant sex-specific difference ($P > 0.05$). We observed highest incidence or risk of VL in persons 5–14 years of age compared with other age groups but this difference was not statistically significant ($P > 0.05$). Incidence or risk showed a decreasing trend with age. The incidence or risk was lowest in the children less than four years of age.

Based on the age- and sex-specific distribution of incidence proportion per 1,000 persons, we estimated total expected VL cases in source population. The ratios of under-reported cases to reported cases were 4.74 (95% CI = 4.11–5.47) in males and 3.51 (95% CI = 2.99–4.11) in females, which indicated no significant difference in the level of under-reporting between males and females ($P > 0.05$). The overall magnitude of VL cases not reported to government agencies was 4.17 times (95% CI = 3.75–4.63) times higher than in cases reported to the government agencies. The level of under-reporting was significantly higher among persons ≥ 30 years of age than in persons < 30 years of age ($P < 0.05$).

In the present study, we attempted to stratify the incidence proportion or risk taking age and sex into account to minimize the effect of confounding. Age and sex distribution of VL patients had shown that all age group were affected, but most of the cases were in children and young adults as reported in Bihar and West Bengal.^{14–22} The male-to-female ratio of VL cases was in ranged from 1.7:1 to 5.5:1 in hospital-based and

population surveys.^{20,21} In the present study, nearly 65–75% of the cases were in persons 5–14 and 15–29 years of age, and male-to-female ratios were 1.15:1 and 1.47:1 in the source and study populations, respectively. Thus, the overall incidence proportions estimated were age-sex weighted averages of incidence proportion rather than crude incidence proportion.

We did not find any sex-specific statistically significant differences in under-reporting of VL cases. However, if we observed 95% CIs for levels of under-reporting for males (4.11–5.47) and females (2.99–4.11), the two CIs slightly overlap (P value close to 0.05), which indicated higher levels of under-reporting for males than for females. This finding could be caused by sex bias, which is widely prevalent in rural areas, and needs to be investigated further.

There was a clear indication of significant age-specific variation of under-reporting. The extent of under-reporting was much higher in persons ≥ 30 years of age than in persons < 30 years of age. The reason for observing age-specific differences in under-reporting of VL cases could be caused by sociocultural and economic factors in rural areas, which needs further investigation.

There are many factors that can influence under-reporting of VL cases in disease-endemic areas. Visceral leishmaniasis is known to occur in clusters in disease-endemic areas.²³ Within one area of high endemicity, some public health centers/areas have higher incidences than other public health centers/areas. Also, under-reporting of VL cases could be an outcome of synergistic effects of many factors such as sociocultural factors, economic status, availability and use of healthcare facilities, attitude towards government health facilities, and awareness of VL. These factors may vary from one disease-endemic area to another and can lead to marked variation in under-reporting. These factors were not taken into account in our study and could be a limitation.

Currently, there is no established system for referring patients from specific public health centers to district hospitals or medical colleges. Therefore, the same patient (e.g., partially treated or relapsed patients) may be recorded twice if he or she moves from one level to another.¹¹ This movement could lead to slight variation in the incidence of VL cases reported to government health facilities.

Under-reporting of VL is a serious issue that needs to be properly addressed. The state health department in consul-

TABLE 1

Age and sex distribution of incidence per 1,000 persons of visceral leishmaniasis in study and source populations and ratio of unreported to reported cases*

Age group, years	Incidence per 1,000 study population (95% CI)			Incidence per 1,000 source population (95% CI)			Ratio of under-reported to reported (95% CI)		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
0–4	1.02 (0.25–4.05)	2.79 (1.16–6.68)	1.86 (0.89–3.90)	0.61 (0.37–1.02)	0.76 (0.47–1.23)	0.69 (0.48–0.97)	0.66 (0.30–1.48)	2.65 (1.52–4.63)	1.72 (1.11–2.66)
5–14	8.81 (6.44–12.04)	7.75 (5.43–11.07)	8.32 (6.57–10.52)	1.60 (1.30–1.97)	2.10 (1.73–2.55)	1.84 (1.59–2.12)	4.50 (3.57–5.67)	2.69 (2.14–3.37)	3.53 (3.00–4.15)
15–29	7.44 (5.29–10.44)	3.73 (2.21–6.30)	5.74 (4.32–7.63)	1.45 (1.17–1.81)	1.20 (0.93–1.56)	1.34 (1.13–1.58)	4.12 (3.23–5.26)	2.10 (1.53–2.89)	3.29 (2.72–3.99)
30–44	7.54 (5.06–11.22)	4.34 (2.47–7.63)	6.05 (4.37–8.38)	0.61 (0.41–0.91)	0.52 (0.33–0.83)	0.57 (0.42–0.77)	11.42 (7.53–17.33)	7.27 (4.44–11.90)	9.64 (7.02–13.25)
45–59	3.12 (1.30–7.48)	5.91 (2.96–11.78)	4.40 (2.56–7.56)	0.65 (0.38–1.13)	0.18 (0.06–0.55)	0.44 (0.27–0.71)	3.77 (2.05–6.95)	32.08 (10.17–101.2)	9.08 (5.42–15.21)
≥ 60	1.60 (0.40–6.36)	3.25 (1.05–10.03)	2.30 (0.96–5.51)	0.45 (0.22–0.95)	0.26 (0.08–0.82)	0.37 (0.20–0.69)	2.53 (1.06–6.07)	11.34 (3.49–36.92)	5.18 (2.63–10.18)
Total	6.22 (5.14–7.53)	4.98 (3.96–6.27)	5.65 (4.88–6.54)	1.08 (0.95–1.23)	1.10 (0.96–1.27)	1.09 (0.99–1.20)	4.74 (4.11–5.47)	3.51 (2.99–4.11)	4.17 (3.75–4.63)

* CI = confidence interval.

tation with the state government should enact legislation that makes it mandatory for all private clinics and doctors to report not only VL cases but any diseases being diagnosed and treated by them to state health agency. This legislation will help in developing a complete database related to all major public health problems and providing an impetus to health planners and policy makers for setting priorities.

Received May 5, 2009. Accepted for publication August 25, 2009.

Acknowledgments: We thank the field staffs for collection of records and data from the field and technical support, and the medical officers of primary health centers in Lalgaon and Goraul for providing official data.

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