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VECTOR ECOLOGY IN ENDEMIC AND NONENDEMIC AREAS OF KALA-AZAR IN BIHAR AND JHARKHAND STATES OF INDIA

Diwakar Singh Dinesh[*1], Prashant Kumar[2], Annadurai Jeya Kumar[1], Maneesh Kumar[1], Roshan Kamal Topno[1], Pradeep Das[1]

[1]Indian Council of Medical Research - Rajendra Memorial Research Institute of Medical Sciences, Agamkuan, Patna-800007, India.
[2]District Health Society, Patna.

***Corresponding Author: Diwakar Singh Dinesh**
Indian Council of Medical Research - Rajendra Memorial Research Institute of Medical Sciences, Agamkuan, Patna-800007, India.

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ABSTRACT
Visceral Leishmaniasis is a major health problem of Bihar, India. It is under elimination mode. However, the transmission of the disease is dependent on the ecological and environmental conditions of the locality. The presence of critical density of sandfly vector in the locality is also a major factor in the transmission of the disease. Diversity in the population of sand flies in endemic and nonendemic areas of Jharkhand and Bihar in India was correlated with the respective ecological and environmental conditions. The Man Hour Density (MHD) of the Kala-azar vector; *Phlebotomus argentipes* was found 5.2 and 1.8 in non endemic area of Jharkhand and endemic region of Bihar respectively over a year 2008-09. The soil was found red in non endemic areas of Jharkhand whereas alluvial soil was present in Kala-azar endemic areas of Bihar. Sand flies were found scattered in dwellings distributed in whole areas in endemic region of Bihar but were confined in particular dark mud house having cattle sharing the room of human dwelling in Jharkhand. All factors responsible for the transmission of the disease like the presence of infected host, ability of vector in the region to pick up parasite, proper development of parasite in the gut of vector and its transmission in fresh host under suitable environmental conditions were present in endemic zone of Kala-azar in Bihar but only vector density was found than other factors including absence of source of parasite in Jharkhand. The findings will be helpful in distinguishing endemic and nonendemic regions of Kala-azar.

KEYWORDS: Kala-azar, Sandfly, Endemic, Non-endemic, Ecology.

INTRODUCTION
Kala-azar (KA) or Visceral Leishmaniasis (VL) is the second largest parasitic killer in the world after malaria.[1] It is caused by a protozoan parasite *Leishmania donovani* and transmitted by the proven vector *Phlebotomus argentipes* (Diptera: Psychodidae)[2]. More than 60 per cent of world's VL cases are reported from the three countries India, Nepal and Bangladesh and spreading to the other states. As many as 200 million people in 109 districts are at risk of contracting the disease.[3,4,5] About 500 000 new cases and 60 000 deaths occur every year and, in the absence of appropriate and timely treatment, most patients die.[6] Four out of 18 districts of Jharkhand and 33 out of 38 districts in Bihar are affected from Kala-azar. The geographical position of both is slightly different. Jharkhand state is stretched between $21^0$59' ~ $25^0$18'30" N and $83^0$59' ~ 25^0 18'30E and the highly endemic Bihar state in between 21°-58'-10" ~ 27°-31'-15" N and 82°-19'-50" ~ 88°-17'- 40". The ecological and environmental conditions as well as human habitat with association of cattle are different in both states. Cattle are in outdoor or indoor habitat in Bihar, however there is separate room in the same premises of the human dwellings in non endemic area of Jharkhand.

There are reports on morphological variations in *P. argentipes* population in the strains of Bihar.[7] Presence of sibling species in *P. argentipes* complex has been reported from India like of *P. argentipessensu stricto*, *P. annandalei* and *P. glacus*[8]. As yet, it is not known, which are involved in transmission of Kala-azar in the country. The soil is red in non endemic areas of Jharkhand whereas alluvial soil is present in endemic areas of Bihar. The factors responsible for the transmission of the disease like the presence of infected host, ability of vector in the region to pick up parasite, proper development of parasite in the gut of vector and its transmission in fresh host under suitable environmental conditions need to be compared in both endemic and non endemic zones for further recognition of possibility of Kala-azar transmission in the particular region. The findings will be helpful to defining endemic and nonendemic regions of Kala-azar.

MATERIAL AND METHODS

A cross-sectional entomological survey for sand flies was conducted in three villages each from Bihar and Jharkhand states during 2008-2009. The villages of Bihar were from three different endemic districts of Kala-azar like Samastipur (vill.: Mohanpur), Vaishali (vill.: Majlishpur) and Patna (vill.: Gulmehiyabagh) having different biotopes in different locations.The non endemic villages Chetu from Gumla district and Kadujora and Hariharpur villages from Ranchi district of Jharkhand from different locations were selected for the study. The topography of Bihar and Jharkhand are different (Fig.;1 and 2).

Fig 1: Topography of endemic village in Bihar.

Fig-2: Topography of nonendemic village in Jharkhand.

Sand flies were collected using aspirator and flash light from indoor resting sites of human dwellings and cattle-shed in the morning hours. *P. argentipes* was scrutinized under dissecting microscope using the key of Lewis (1978).[9] Ecological and environmental conditions were recorded from all collection sites.

RESULTS AND DISCUSSIONS

The density of sand flies depends on microclimatic and ecological conditions at particular place as it was found in Bihar and in some parts of Jharkhand, India. Sand fly breeding sites were found inside the mixed dwellings (cattle and human) at Jharkhand. Bihar shares the disease in 33 districts out of 38, whereas; Jharkhand shares in four neighboring districts out of 18 districts. There are certain differences in the geographical distribution and climatic conditions of both states. In Jharkhand the temperature ranges 10^0C to 40^0C. The average annual rainfall is 125-150cm. The population of the state is 26909428. Bihar is expended in total area of 94,163.00 sq. kms and the population is 8,28,78,796 situated in the lower and middle Gangetic region. The annual temperature varies from 6^0C to 43^0C. Normal rainfall is 1,205 mm.

There are certain districts which have never been affected with this type of disease. The study was made keeping in view finding out the presence or absence of vector species in nonendemic area of Jharkhand and in endemic areas of Bihar to compare with the associated factors like their density, species composition, ecology of house, nature of soil and association of human and cattle. In the non endemic area of Jharkhand the density of sand flies was found very high due to their living style. Sand flies prefer animal blood, dark and humid places. People at Jharkhand keep their cattle in dark room. The house is generally made of mud with tiled roof. The rooms inside are very congenial to sand flies hence the density was found very high. But sand flies could not be collected from other than such house due to their nature of soil i.e. Reddish, rocky and dry. In Bihar animals are being kept mostly in small huts or in open sky or partial shed and sometimes inside room that are very suitable environment for breeding to sand flies. Sand flies prefer cattle blood either from domestic or peridomestic situations. For the resting and breeding sites of sand flies three types of soils are essential which is found in all endemic areas i.e. alluvial, swamp and terai having pore capacity to hold water molecule for longer period i.e. prime requirement for the development of larvae and resting of adult sand flies. Hence, the disease transmission is frequent in these particular areas since more than century. But there is no history of disease in such non endemic area of Jharkhand.

Sand flies of two genus of *Phlebotomus* (*P. argentipes* and *P. papatasi*) and *Sergentomyia (Sergentomyia sps.)* were also collected from Jharkhand where as only *P. argentipes* and *Sergentomyia* sps were collected from Bihar. The density of *P. argentipes* was more than *P. papatasi* in Jharkhand. In total 945 sand flies were collected during the survey with 57.9 per cent *P. argentipes*, 1.4 per cent *P. papatasi* and 40.6 per cent *Sergentomyia* sp. The man hour density (MHD) of *P. argentipes* and *Sergentomyia* sp. is higher in Jharkhand than in Bihar. The density of vector species i.e. *P. argentipes* was 1.83 in Bihar and 5.2 Man Hour Density (MHD) in Jharkhand.

Table: Village Wise Indoor Density of Sandflies From Endemic and Nonendemic Areas Of Kala-Azar.

Place	District	Villages	Sandfly(n)			Total
			Pa	Pp	Sr	
Endemic (Bihar-State)	Samastipur	Mohanpur	7	0	5	12
	Vaishali	Majilispur	3	0	2	5
	Patna	Gulmehiyabagh	12	0	5	17
Non-endemic (Jharkhand-State)	Gumla	Chetu	42	2	15	59
	Ranchi	Kadojora	2	0	2	4
		Hariharpur (Bair Toli)	18	0	30	48
		Total	**84**	**2**	**59**	**145**
		Grand Total (%)	**57.93**	**1.38**	**40.69**	

The high density of sand flies was found in endemic area of Bihar in comparison to epidemic zone due to high contact rate with sand fly which provide protection by inoculating saliva protein in human body.[10,11,12,13] The nature of house was different in both places. Houses were made of mud and tiled roof sharing with cattle in separate room inside same premises. Sometimes cattle are in the same premises or outside the house. The house was made of brick with mud and tiled roof, a few mud with tiled roof and huts. The rooms were ill ventilated, larger and dark at Jharkhand in comparison to Bihar. It seems that presence of sand flies is not mare dependent on the nature of soil. It may present in any endemic or nonendemic area under congenial microclimatic conditions in association with cattle. The nature of house depends on socioeconomic conditions of the population. In a study among low socio-economic groups in both areas in Bihar the houses were found made of soil and bamboo sticks; some houses were made of bricks without cement plastering. However, with few exceptions, Kala-azar cases also occurred in concrete houses in north and south Bihar. Both areas have some soft stem vegetation, such as plant of *Musa sapientum*, creepers etc. in the peridomestic region that resembles with the study as risk factor for Kala-azar transmission.[14] The potential indoor breeding sites like cracks and crevices of wall can be sealed by using brick chimney fly ash and lime to get environmental control of sandfly population.[15]

The study proves that *P. argentipes* requires the microclimatic conditioned irrespective of geographical distribution. The diversity is quite distinct in the environmental factors, ecological conditions and sand fly status in both states. There may be sibling species of among *P. argentipes* which might be different due to different geographical distribution or morphologically different that can be assessed to know the factors associated with transmission of the disease.

This study will lead for extensive study in finding the potentiality of *P. argentipes* of both regions in transmission of the disease. The programme should be aware for presence/absence of vector species of Kala-azar in endemic and nonendemic zone for implementation of effective control measures.

CONCLUSION

The presence of critical density of sandfly vector in the locality is also a major factor in the transmission of the disease. The Man Hour Density (MHD) of the Kala-azar vector; *Phlebotomus argentipes* was found 5.2 and 1.8 in non endemic area of Jharkhand and endemic region of Bihar respectively. Factors responsible for the transmission of the disease were present in endemic zone of Kala-azar in Bihar but only vector density was found than others in the non endemic area of Jharkhand. The findings will be helpful to recognise endemic and nonendemic regions of Kala-azar.

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