**Report VL in Bihar**

Introduction: Visceral Leishmaniasis (VL), also known as kala azar, is a vector-borne disease that is caused by obligate intra-macrophage protozoa and is fatal if left untreated. On the Indian subcontinent (ISC) it is caused by *L.donovani* and transmitted between human hosts by the sand fly *P.argentipes*. Because in the ISC humans are assumed to be the only reservoir, preventing transmission with bed nets could have an individual benefit as well as a public health benefit. The main objective of our study was to assess the protective effect of bed net use against VL under routine conditions. We also investigated other risk factors potentially associated with the disease.

Methods: We conducted a survey in village X with an estimated population of 2,000. We interviewed heads of households and collected information on all those aged 2 years and above. After collecting data on age and gender of all inhabitants of each house, we asked whether anyone had suffered VL in the past two years. All cases reported were verified from medical records by a study physician. We also included those reported to have died from VL during this period. Detailed questions about bed net use were asked for each family member. Regular use of a bed net was defined as sleeping under a bed net at least 10 months per year.

Apart from data on VL and bed net use we also collected data on ownership of a number of durable consumer goods at the level of the household. This information was used to create an asset-index based on which the population was divided into 5 quintiles of wealth distribution. We asked whether or not a household belongs to the scheduled casts. We also collected information on housing and environmental conditions and on ownership of animals. Animals could either attract sand flies to the houses or divert sand flies away from humans. Environmental factors such as the presence of certain trees, water bodies and organic material such as cow dung could affect sand fly abundance.

We calculated the annual incidence rate of VL and the case fatality rate. We also calculated the population attributable risk fraction of not using bed nets. For each of the factors recorded we assessed associations with VL in univariate logistic regression models, calculating odds ratios. Any association that was found to be statistically significant at the level of α=0.10 in univariate analysis was assessed as a potential confounder in the association between bed net use and VL in bivariate analysis. We then included in a multivariate model bed net use and all other factors significant at the level of α=0.10 in the univariate models. We removed one at a time secondary exposures that did not significantly improve precision of the model and that did not change the odds ratio of bed net use by more than 10%. With the variables retained, we checked for interactions between the variable of interest (bed net use) and each of the secondary exposures, for this purpose categorical variables with more than two levels were recoded to binary. Finally we assessed whether ordinal variables with more than two levels could be treated as numerical by comparing the model treating such factors as categorical to a model treating them as numerical.

Age was subdivided into 3 categories, 0-14 years, 15-34 years, and 35 years and above.

Results

We enrolled 1,880 subjects, 907 (48.3%) were female. Median age was 19.5 years (IQR 8-35), data on age was missing for two subjects. Over the 2-year period 207 cases of VL were recorded on a population of 1880, equivalent to an incidence rate of 55/1000 population per year. Three persons died, resulting in a case fatality rate of 1.4% . Only 20% of subjects enrolled reported regularly using a bed net. Further details are presented in table 1.

Table 1: Characteristics of study population

|  |  |
| --- | --- |
| **Factor** | **Number (%)** |
|  |  |
| Female gender | 907 (48.2) |
|  |  |
| Age group (n=1878) |  |
| * 0-14 years | 765 (40.7) |
| * 15-34 years | 608 (32.4) |
| * 35 years and above | 505 (26.9) |
|  |  |
| Socio economic status |  |
| * Group 1 (poorest) | 447 (23.8) |
| * Group 2 | 374 (19.9) |
| * Group 3 | 325 (17.3) |
| * Group 4 | 392 (20.9) |
| * Group 5 (wealthiest) | 342 (18.2) |
|  |  |
| Scheduled caste | 72 (3.8) |
|  |  |
| Uses bednet regularly | 373 (19.8) |
|  |  |
| Housing characteristics: |  |
| * Thatched walls | 776 (41.3) |
| * Earth floor | 1709 (90.9) |
| * Graneries in house | 1074 (57.1) |
|  |  |
| Presence near house of: |  |
| * Neem tree | 758 (40.3) |
| * Bamboo tree | 736 (39.1) |
| * Banana tree | 1576 (83.8) |
| * Rice field | 1501 (79.8) |
| * Permanent water body | 863 (45.9) |
|  |  |
| Ownership of: |  |
| * Bovines | 719 (38.2) |
| * Goats | 598 (31.8) |
| * Poultry | 81 (4.3) |

On univariate analysis we found a moderately strong protective effect against VL of regularly using a bed net, OR 0.5 (95% CI 0.3-0.8). The population attributable fraction (PAF) of no bed net use is (207/1880-23/373)/(207/1880) = 44%, indicating a major potential benefit of increased bed net use.

Other factors that are associated with VL in our study population on univariate analysis are: age<15, socio economic status, belonging to the scheduled casts, living in a house with thatched walls or earth floors and having a bamboo tree near the house. Most of these were moderately strong risk factors (RR >1 but < 2), the associations with the poorer quintiles of the asset index, belonging to the scheduled casts, and living in a house with earth floors were much stronger (table 2).

Table 2: univariate associations with VL (n=1880)

|  |  |  |  |
| --- | --- | --- | --- |
| **Factor** | **Cases**  **(n=207)** | **Non cases (n=1673)** |  |
|  | **Number (%)** | **Number (%)** | **OR (95% CI)** |
|  |  |  |  |
| Female gender (n= 1879) | 107 (51.7) | 800 (47.8) | 1.2 (0.9-1.6) |
|  |  |  |  |
| Age group (n=1878) |  |  |  |
| * 0-14 years | 99 (48.1) | 666 (39.8) | 1.6 (1.1-2.3) |
| * 15-34 years | 63 (30.6) | 545 (32.6) | 1.2 (0.8-1.8) |
| * 35 years and above | 44 (21.4) | 461 (27.6) | ref. |
|  |  |  |  |
| Uses bednet regularly | 23 (11.1) | 350 (20.9) | 0.5 (0.3-0.7) |
|  |  |  |  |
| Socio economic status |  |  |  |
| * Group 1 (poorest) | 71 (34.3) | 376 (22.5) | 4.1 (2.4-7.6) |
| * Group 2 | 59 (28.5) | 315 (18.8) | 4.1 (2.3-7.6) |
| * Group 3 | 33 (15.9) | 292 (17.5) | 2.5 (1.3-4.8) |
| * Group 4 | 29 (14.0) | 363 (21.7) | 1.7 (0.9-3.4) |
| * Group 5 (wealthiest) | 15 (7.2) | 327 (19.5) | ref. |
|  |  |  |  |
| Scheduled caste | 32 (15.5) | 40 (2.4) | 7.5 (4.5-12.2) |
|  |  |  |  |
| Housing characteristics: |  |  |  |
| * Thatched walls | 117 (56.5) | 659 (39.4) | 2.0 (1.5-2.7) |
| * Graneries in house | 118 (57.0) | 956 (57.1) | 1.0 (0.7-1.3) |
| * Earth floor | 201 (97.1%) | 1508 (88.2) | 3.6 (1.9-9.4) |
|  |  |  |  |
| Presence near house of: |  |  |  |
| * Neem tree | 74 (35.7) | 684 (40.9) | 0.8 (0.6-1.1) |
| * Bamboo tree | 96 (46.4) | 640 (38.3) | 1.4 (1.0-1.9) |
| * Banana tree | 171 (82.6) | 1405 (84.0) | 0.9 (0.6-1.3) |
| * Rice field | 173 (83.6) | 1328 (79.4) | 1.3 (0.9-2.0) |
| * Permanent water body | 81 (39.1) | 782 (46.7) | 1.0 (0.7-1.3) |
|  |  |  |  |
| Ownership of: |  |  |  |
| * Bovines | 81 (39.1) | 638 (38.1) | 1.0 (0.8-1.4) |
| * Goats | 72 (38.8) | 526 (31.4) | 1.2 (0.9-1.6) |
| * Poultry | 13 (6.3) | 68 (4.1) | 1.6 (0.8-2.8) |

On multivariate analysis bednet use was no longer significantly associated (OR O.8, 95% CI 0.4-1.2) but we kept it in the model as our main factor of interest. The main confounder was socio economic status, expressed as asset index as a proxy for wealth quintiles. From the second quintile onwards there was a clear decrease in risk with an increase in wealth, though the only difference that was statistically significant was between the poorest and the wealthiest quintile (0R 0.4, 95% CI 0.2-0.7. Belonging to the scheduled casts remained the strongest risk factor, even after controlling for wealth quintile, with an odds ratio of 6.2 (95% CI 3.6-10.5). Having bamboo trees near the house was a statistically significant but weak risk factor (OR 1.5, 95% CI 1.1-2.0). Details are provided in table 3.

We tested for interactions between bednet use and the other three factors retained (bamboo tree, assets and scheduled caste) but none were statistically significant.

Table 3: Factors associated with visceral leishmaniasis (multivariate analysis)

|  |  |
| --- | --- |
| **Factor** | **OR  (95% CI)** |
| Bed net use | 0.8(0.5-1.2) |
| Scheduled caste | 6.2 (3.6-10.5) |
| Socio economic status |  |
| * Group 1 (poorest) | Ref. |
| * Group 2 | 1.3(0.9-1.9) |
| * Group 3 | 0.8(0.5-1.3) |
| * Group 4 | 0.6(0.4-1.0) |
| * Group 5 (wealthiest) | 0.4(0.2-0.7) |
| Bamboo tree near house | 1.5 (1.1-2.0) |

Discussion:

On univariate analysis we found a moderately strong and statistically significant protective of regular bed net use with an odds ratio of 0.5 (95% CI 0.3-0.7). The population attributable risk fraction was 44%, indicating a large potential benefit of bed net distribution. However upon controlling for poverty, the odds ratio went up to 0.8 and was no longer statistically significant (95% CI 0.5-1.2).

Bed nets may have a protective effect but the current study does not provide enough evidence. We also did not assess the quality of the bed nets and these were mostly ordinary bed nets, not insecticide treated. Since currently less than 20% use a bed net, there certainly is a potential for increased use of bed nets to reduce VL incidence but a larger study is required to provide the evidence. Preferably this should be a cluster randomized trial.

Having a bamboo tree near the house is a marginally significant but weak risk factor. Belonging to the scheduled casts is a strong risk factor even after controlling for socio economic status and would warrant specific control measures targeting these populations.

Conclusion:

Based on the data available from this study we cannot make a firm recommendation for distribution of bed nets to be implemented as a VL control measure. However our study was observational only, a cluster randomized trial with insecticide treated nets could provide a more definite answer.