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Nepal: Analysis of Baseline Survey Data on Japanese Encephalitis, Kala-azar and Malaria

HMG MoH/USAID Program for the Prevention and Control
of Selected Infectious Diseases in Nepal

by

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Acronym List

AS	Animal Shed
CDC	Centers for Disease Control and Prevention
DAT	Direct Agglutination Test
EHP	Environmental Health Project
FF	Forest Fringe
HRV	Highland River Valley
IHD	Indoor Human Dwelling
IT	Inner Terai
JE	Japanese Encephalitis
KA	Kala-azar
MAL	Malaria
MOH	Ministry of Health
OHS	Outdoor Human Shelter
OT	Outer Terai
SES	Socio-economic Status
USAID	United States Agency for International Development
VBD	Vector-borne Disease
VDC	Village Development Committee

Executive Summary

The potential risk factors of vector-borne diseases can vary from one household/population group to another. To understand potential risk factors better, this study introduces various household/population groups in Nepal and analyzes potential risk factors for malaria (MAL), kala-azar (KA) and Japanese encephalitis (JE) across these groups. This report describes Socio-economic and demographic characteristics of the study population and respondents, examines variations in two potential bed net risks, and analyzes survey findings for lessons on how to make interventions for these diseases more effective.

Socio-economic and demographic characteristics

The study population of 5,700 households averaged 6.8 members. The composition of the 38,906 household members was 51% male/49% female, 38% 15 years of age or younger/62% older, and 56% literate/44% illiterate. Respondents of the survey were either heads of households or household members they recommended. The breakdown of the 5,700 respondents was 63% male/37% female and 55% literate/45% illiterate. Of the total respondents, significantly more males were literate than females.

Socio-economic status (SES) did not vary significantly across the three disease-specific samples. Higher SES was associated with a greater ownership of durable consumer goods and livestock (except for pigs), greater literacy and household size.

The 1991 population census found 58% of nearly 10 million residents of the terai reporting terai rather than hill or mountain origin (hereafter hill origin). The baseline survey found household distribution by group of origin tended to remain the same within each disease-specific sample, but differed across place of residence (eco-region), whether terai or hill. The adult literacy rate of the terai-origin population was relatively lower than that of the hill group. The average household size of terai-origin households was relatively larger than hill-origin households. Household SES was relatively lower in hill- than terai-origin samples. The two caste/ethnic groups also differed in settlement patterns, housing conditions and sleeping behaviors.

Geographic variation in indicators was considerable within a given disease-specific sample, implying that variations in socio-demographic indicators were high across the surveyed area and low across the disease-specific samples. Therefore, the three disease-specific samples produced consistent results regarding the common variables.

Socio-demographic indicators varied across four eco-regions—forest fringe, inner terai, outer terai and highland river valley. The overwhelming majority of the outer terai population was of terai origin with low literacy, large household size and virtually no pig farming. In contrast, the overwhelming majority of the inner terai population was of hill origin with relatively high literacy, small household size and small-scale pig farming. The adult literacy rate was slightly higher in the East than in the West, the percentage of terai-origin households was slightly higher in the West than in the East. The SES of households in the East appeared relatively better than in the West.

Potential bed net risks and their variation

Because bed nets are an important means of protection against vector bites, the study examined variations across several household groups in two potential bed net risks and then analyzed their association with household-level Socio-economic status and size.

Nearly 73% of households had at least one bed net; 27% of households were at potential risk of vector bites; and by not protecting every member, 37% of households with at least one bed net were at risk for vector bites. The risk presented by lacking a bed net was highest in the highland river valley followed by the inner terai, outer terai and forest fringe. The risk presented by not having enough bed nets to protect all members was highest in the outer terai followed by the highland river valley, inner terai and forest fringe. Both risks were higher in the West than in the East. The percentage of households with no bed nets was almost uniform between terai- and hill-origin households. In contrast, the percentage of households lacking protection of all household members was nearly twice as high among terai- compared with hill-origin households. As Socio-economic status increases both risks decrease. The risk presented by lack of a bed net increases as household size increases, reaching its maximum at a household size of six and then tending to decrease. In contrast, the risk presented by lack of bed net protection for all household members continues to increase as household size increases. This explains why terai-group households, which tend to be larger, were at greater risk of leaving some household members unprotected.

Lessons for effective malaria interventions

Malaria has been endemic in the lowlands of Nepal for several decades. The vast majority of terai residents probably live in malaria-risk areas, and as many as half of hill residents remain at risk, placing an estimated 16 million people at risk in both areas. The current reporting system likely does not report the true number of malaria cases, due to declining slide testing and increasing slide positivity; malaria occurrence may be focal sporadic outbreaks—at least in the terai—which carry high mortality, particularly in pregnant women.

Humans are the intermediate hosts and mosquitoes the definitive hosts for malaria. Most species bite mostly in the evening. No animal reservoir or amplification exists, although livestock attract the vector and may increase exposure to humans. Known risk factors for malaria include the presence of vector breeding sites, increased attraction of vectors (from livestock), failure to use bed nets and other risky sleeping behavior, travel to endemic areas, and, to a degree, presence of other cases in the family or community.

Survey findings raised a number of implications for different types of interventions identified by the Nepal Ministry of Health (MOH) as priorities for addressing malaria:

- *Information, education, and communication.* High awareness of malaria was relatively equally distributed across geographic and ethnic groupings. Awareness did not suggest greater familiarity with the disease and thus did not identify high-risk areas. The data did not suggest a pattern useful for targeting interventions for endemic malaria, although this may be different for an outbreak (epidemic) situation. Most respondents had a reasonable understanding of the disease, its transmission, and case management, although most did not know the name of the appropriate medicine for treatment.

- *Behavior change interventions.* Although bed net use was high, the percentage of households leaving someone unprotected was higher in the highland river valley eco-region, suggesting that a targeted intervention to increase total bed net coverage may be appropriate there. Although awareness was high, risky sleeping behavior was higher among those not aware, suggesting that improving awareness in this group could reduce risk. Reasonable understanding of environmental risk factors existed, but the survey did not determine whether behavior change could reduce these risks.

- *Environmental interventions.* The government currently implements spraying as one environmental intervention. Many respondents believed spraying would not prevent malaria, and only a few reported spraying, because no one from Public Health had come to spray. Those receiving spraying often plastered or painted their houses in a few months. Spraying did not seem a highly prized intervention. Attitudes on its role in protecting against malaria were mixed.

- *Capacity building.* Understanding of disease management was better when health workers were a source of information, suggesting that if health workers were more active educators, case management might improve. Although most believed that the government has responsibility for controlling malaria, confidence in preventive and clinical services was low. However, among those with cases, use of facilities and compliance with recommendations was high. This suggests that improvements in service delivery and community trust in it should improve the use of and compliance with treatment regimens.

Lessons for effective kala-azar interventions

Kala-azar or visceral leishmaniasis is a chronic, systemic disease, which if left untreated, has a high fatality rate. In Nepal, children, young adults and slightly more males are most affected. Case management, currently free, is not optimal. Patients commonly travel to India for treatment. Risk derives from exposure to the sand fly vector, which may breed in mud and dung. Transmission is from person to person without an amplifier host. However, sand flies feed on livestock. The few studies on risk factors suggest household clustering of cases and chiefly exposure to others with sub-clinical disease. Some studies suggest proximity to livestock and vector presence are not strong risk factors.

In this study, most cases had limited awareness of the disease or currently free treatment. Identification of new disease clusters suggests that neither surveillance nor treatment has adequately reached the population. The study confirmed that risk is higher among the poor and illiterate. Behavioral risks include sleeping on the floor, sleeping on the ground floor rather than the first floor, and sleeping without a bed net. Environmental risks include having a damp floor and house wall cracks. However, no risk was associated with proximity to livestock. Although not a comprehensive vector prevalence survey, the survey found unequal geographic distribution. The outer- or inner-terai had the most and the West somewhat higher percentages of vector-positive houses.

Survey findings raised a number of implications for different types of interventions identified by MOH as priorities for addressing kala-azar:

- *General information, education, and communication.* Awareness for KA was very low, but appeared associated with some familiarity with the disease. Awareness did not impart understanding of the disease, even recognizing the sand fly as the vector, suggesting almost no understanding of potential risk factors. Clustering of indicators of familiarity with the disease appeared to occur in the east and outer terai; Sarlahi district had the highest risk. Some aspects of disease risk and case management were vaguely understood (such as high mortality and long treatment length), but few were aware of free treatment or had much confidence in health facility treatment.

- *Behavior change.* Behavioral interventions for KA differed from those for other vector-borne diseases, because of the nature of the vector and the lack of proven efficacy among other common interventions. Most households exhibited some risky sleeping behavior, but increased awareness of KA reduced this behavior. Risky sleeping behavior was also not dramatically different for different eco-regions or from east to west. The vast majority of households had several environmental risk factors encouraging vector breeding. Environmental risk factors did not clearly segregate from east to west or by eco-region, as might be expected from the significant differences in awareness geographically. Increased awareness influenced some risk factors, but not as clearly as with JE.

- *Environmental interventions.* Environmental interventions not tied to household behavior, mainly spraying, may also be important. No pattern of spraying appeared to exist, suggesting it was done in higher-risk areas. Most believed the government was responsible for managing KA and seemed to favor spraying, but noted it simply was not being done.

- *Capacity building.* Focusing on higher-risk areas identified through strengthened surveillance could strengthen interventions. Clinical case management and community acceptance of health facilities varied dramatically from area to area and depended greatly on health care provider motivation and skill. Improved case recognition and management and winning the confidence of communities may be critical to a VBD program. A perception of need for government services, but lack of full confidence in those services clearly existed. Community recognition of KA was limited, which is understandable because few have seen a case. Improved recognition through education could increase reporting of possible cases and help target interventions. More data are needed on health worker recognition of KA and the ability of the current surveillance system to capture cases and trigger a response.

Lessons for effective Japanese encephalitis interventions

Japanese encephalitis is a devastating disease of relatively low prevalence in Nepalese lowlands and is transmitted by Culex mosquitoes and usually not by humans—wild birds and pigs are amplifying hosts. Children make up most of the estimated 40 victims per 100,000. Most infections are asymptomatic, yet, of serious ones, one-third die and one-third have serious neurologic sequelae. Not enough is known on how JE is spread, but it may be through agricultural practices that increase vector breeding sites and animal husbandry practices. Preventive measures have yet to affect its spread dramatically. Spraying and larvicide application to rice fields and swine vaccination have been tried without clear success, perhaps due to the difficulty of broad application. Human vaccination is effective.

Vector-positive households were distributed across all three eco-regions, with somewhat more in the forest fringe. Vector density in general was not high, making close examination difficult. Vector density tended to be lower in animal sheds in the east and higher in animal sheds in the west for both pre- and post-monsoon collection. Vector density tended to be slightly higher in the East pre-monsoon, but tended to be higher in the West post-monsoon.

Survey findings raised a number of implications for different types of interventions identified by MOH as priorities for addressing Japanese encephalitis:

- *Information, education, and communication.* A general education campaign has the potential to increase sensitivity to Japanese encephalitis, which could result in both individuals and communities taking steps to minimize their risk and improve the management of cases. Survey findings suggest that awareness increased with Socio-economic status, literacy and radio ownership. Once aware of the disease, general knowledge was reasonable, both for awareness of preventive measures and realistic understanding of case management. General awareness can be improved and is likely to improve overall understanding of the disease. Because general awareness was higher in the forest fringe and the West and among hill origin groups, these represent areas of higher risk in which to target interventions.

- *Behavior change.* Behavioral interventions for JE are not simple, nor a magic solution. JE has, however, been controlled in more developed settings, and improvement should be possible. Awareness of vaccination was low among all groups. If vaccines become available, an awareness campaign could improve usage. Although bed net use was high, protection for all household members can be improved (cost remains a significant factor) and may improve with increased awareness of the disease. Greater ownership of pigs and poultry and, therefore, higher risk in the forest fringe may justify targeting community-based interventions to households of greatest risk there.

- *Environmental interventions.* Environmental interventions for JE involve managing potential breeding sites, reducing suitable habitat for the adult vector, and reducing the risk of exposure in households. JE is relatively rare, so, if the vector is present, transmission is likely only under other conditions. Evidence suggests that JE's domain is expanding; sporadic outbreaks occur in distant areas. Community- or household-level environmental interventions are thus more difficult because a great deal must be done for limited impact on a relatively rare occurrence. The survey found that, were spraying available, it would likely be accepted and perceived as beneficial. Communities could be mobilized to make well-defined specific changes to the environment to reduce risk.

1. Socio-Economic and Demographic Characteristics Across Household/Population Groups

1.1. Introduction

The potential risk factors of vector-borne diseases are found to vary from one household/population group to another. In order to have better understanding of these potential risk factors, this study introduces various household/population groups and analyzes the potential risk factors across these groups. For example, potential risk factors vary geographically, and this variation is related to the complex interplay between literacy, ethnicity and socio-economic status. In addition to other variables, this study uses the two variables—*food sufficiency from own farm production* (Q113) and *caste/ethnicity of household head* (Q13)—to introduce very useful household/population groups.

The main purpose of this chapter is to present the socio-economic and demographic conditions of those household/population groups that will be used in the later phase of the analysis. While doing so, efforts have been made to present the aggregate level results by pulling data on some common variables from the three disease specific samples—*MAL sample, KA sample* and *JE Sample*. Efforts have also been made to establish the association or linkages among the various groups.

Bed nets are an important means of protection against vector bites. In order to motivate, this chapter, as an illustration, presents preliminary analysis of bed net use at the aggregate level. For this purpose, two potential bed net risks will be introduced, and the variations of these two risks will be examined across the several household groups. Finally, the association of these two potential risks with household level socio-economic status and household size will be analyzed.

1.2. Socio-demographic characteristics of household members

A total of 38,906 individuals were recorded as household members in the selected 5,700 households, resulting in an average household size of 6.8 members. About 51% of household members were male and 49% female. Of all the household members, 38% were young (below 15 years of age) and 62% were adult (15 and above years of age). Out of total adult household members, 56% reported to be literate and 44% illiterate during the time of the survey operation. Gender discrepancy in literacy, as in other surveys, continues to persist in the current survey too with 54 literate adult females per 100 literate adult males. It is important to note that these statistics are not comparable with the regularly available national or regional level statistics, since no such area or regional level specific statistics that fit this survey methodology are available in Nepal.

1.3. Socio-demographic characteristics of respondents

The respondents of the current baseline survey are either heads of the selected households or those household members who were recommended by the heads of the households. The make-up of the total 5,700 respondents was 63% male/37% female and 55% literate/45% illiterate. Of the total 3,580 male respondents, 66% were literate and 34% illiterate, and of the total 2,120 female respondents, 36% were literate and 64% illiterate. Table 1 summarizes the age-sex specific literacy rates of respondents.

Table 1. Age-sex Specific Literacy Rates of Respondents (%)

Age Group	Male	Female	Total
15 to 24	88	69	79
25 to 34	79	42	63
35 to 44	66	32	53
45+	53	13	41
Overall	**66**	**36**	**55**

1.4. Food sufficiency and socio-economic status analysis of households

In the present baseline survey, the household level information on food sufficiency out of own farm production (Question 113) collected during the survey operation has been used to construct an indicator of socio-economic status (SES). More specifically, each household is categorized into one of the following three categories of SES—low, medium and high—depending upon whether the food production is sufficient for less than six months, more than six but less than 12 months, or more than 12 months, respectively.

Within each disease specific sample, the percentage of households varies across the three categories of SES. Within each category, SES does not vary significantly across the three disease specific samples (see figures in the first three columns of Table 2), but it varies between the terai and hill samples (see the last two columns of Table 2).

Clearly, the SES of households in the hill sample is relatively lower than that of the households in the terai sample.

Table 2. Variations in SES Across Samples (%)

SES	SES in MA Sample	SES in KA Sample	SES in JE Sample	SES in Terai Sample	SES in Hill Sample
Low	25	25	26	25	48
Medium	48	51	48	49	41
High	27	25	25	26	11

The SES is associated with the percentage of households possessing consumer durable goods (e.g., television, radio and bicycle) in the sense that the percentage of households possessing a consumer durable good increases with the increase in the level of SES (Table 3). Similarly, the percentage of households possessing livestock (e.g., buffalo, cow, goat and pig) also increases with increased SES except in the case of pig ownership.

Table 3. Association of SES with the Possession of Durable Goods and Livestock

SES	Percentage of Households Possessing						
	Television	***Radio***	***Bicycle***	***Buffalo***	***Cow***	***Goat***	***Pig***
Low	7	40	33	30	69	45	11
Medium	12	49	52	46	76	54	9
High	27	64	74	62	81	55	9

The SES is also associated with literacy. The percentage of literate respondents increases from 45% to 56% and then to 70% as the level of SES increases from low to medium and then to high. The SES is also associated with the household size. The average household size of the low, medium and high categories of SES is correspondingly 6.5, 6.9 and 7.5.

1.5. Caste/ethnicity of household heads and grouping scheme of households

The residents of the terai, including the inner terai, (hereafter terai) can broadly be grouped into two groups—one comprising the caste/ethnic groups of terai origin and the other comprising of the caste/ethnic groups of hill or mountain origin (hereafter hill origin). Out of nearly 10 million residents of the terai, 58% reported to be of the caste/ethnic groups of the terai origin during the 1991 Population Census. In the past, residents of the terai have shown considerable variation in socio-economic and demographic characteristics between those of the terai or hill origin (Chhetry, 1996), implying that the two groups may likely have a significant variation in potential risk factors for vector-borne diseases. In the present study, therefore, the information on caste/ethnicity of household heads collected during the survey has been used to classify the households into two broad caste/ethnic groups—terai origin and hill origin. The distribution of the broad caste/ethnic grouping tends to remain the same within each disease specific sample (Table 4), but it differs across place of residence (eco-region), whether residing in the terai or in the hills.

Table 4. Distribution of Households of the Terai and Hill Origin by Disease Dataset

Caste/Ethnic Group	MAL Sample	KA Sample	JE Sample	Terai Residence	Hill Residence
Terai Origin	41	41	42	42	1
Hill Origin	59	59	57	58	99
Total	**100**	**100**	**100**	**100**	**100**

1.6. Some characteristics of terai and hill groups

The survey data clearly demonstrate that the adult literacy rate of the terai origin population is relatively lower than that of the hill group (70% vs. 38%). In addition, the average household size of terai origin households is relatively larger than that of hill origin households (Table 5). Nepali language is reported to be the mother tongue of the overwhelming majority of the heads of households of the hill origin, while the same language is reported to be the mother tongue of less than 3% of heads of households of the terai origin (Table 5).

Table 5. Socio-demographic Variations Across the Caste/Ethnic Group

Caste/Ethnic Group	Adult Literacy Rate (%)	Average Household Size	Percentage of Household Heads with Nepali as Mother Tongue
Terai Origin	38	7.9	3
Hill Origin	70	6.2	89

The two caste/ethnic groups differ not only in socio-demographic characteristics, but also in their settlement patterns, housing conditions and in their sleeping behaviors. In this regard, the present baseline survey clearly demonstrates the following:

- The percentage of houses in clustered settlements is higher among terai origin than among the hill origin households (89% vs. 31%)
- The percentage of houses near the forest is higher among hill origin than among terai origin households (52% vs. 18%)
- The percentage of *kaccha* houses is slightly higher among hill origin than among terai origin households (79% vs. 75%)

- The percentage of single storied houses is relatively higher among terai origin than among hill origin households (82% vs. 39%)

- The percentage of houses with mud floor is relatively higher among terai origin than among hill origin households (94% vs. 82%)

- The percentage of households who reported that some of their family members sleep inside the animal shed is higher among terai origin than among hill origin households (37% vs. 5%)

- The percentage of households who reported that some of their family members sleep outside in the open is higher among terai origin than among the hill origin households (70% vs. 46%).

1.7. Geographic variations

The adult literacy rate and the percentage of terai group households are summarized in Table 6 by disease specific dataset and by surveyed area. Within a given disease specific sample, the range of variation in indicators across the survey areas is considerable. For example, within the JE sample, the adult literacy rate varies from 34% in Sarlahi to 75% in Jhapa, and the percentage of terai origin households varies from 10% in Surkhet to 97% in Kapilvastu. On the contrary, within a given survey area, the range of variation in indicators across the disease specific samples is low. For example, within the survey area of Jhapa, the adult literacy rate varies from 71% in the KA sample to 75% in the JE sample. These results imply that the variations in socio-demographic indicators are high across the surveyed area and low across the disease specific samples. The implication of low variations across the disease specific samples is that the three disease specific samples produce consistent results with regard to the common variables.

Table 6. Socio-demographic Variations Across Disease Specific Sample and Surveyed Area

Surveyed Area	Adult Literacy Rate in Percentage			Percentage of Terai Origin		
	MAL Sample	*KA Sample*	*JE Sample*	*MAL Sample*	*KA Sample*	*JE Sample*
Jhapa	72	71	75	15	17	11
Sarlahi	37	32	34	87	86	88
Chitwan	70	70	69	11	12	14
Surkhet	69	69	69	7	9	10
Kapilvastu	40	37	39	97	95	97
Kanchanpur	52	54	54	33	28	35
Dhankuta	71			0		
Baitadi	66			1		

The variations in socio-demographic indicators across the four eco-regions—Forest Fringe (FF), Inner Terai (IT), Outer Terai (OT) and Highland River Valley (HRV)—are summarized in Table 7. The OT region is characterized by an overwhelming majority of the population of terai origin with low literacy, large household size and virtually no pig farming. On the contrary, the IT is characterized by an overwhelming majority of the population of hill origin with relatively high literacy, smaller household size and small scale of pig farming.

Table 7. Eco-region Variation in Socio-economic and Demographic Indicators

Eco-region	Adult Literacy Rate (%)	Percentage of Households of Terai Origin	Household Size	Percentage of Households Possessing			
				Buffalo	*Cow*	*Goat*	*Pig*
Forest Fringe	62	23	7	42	79	47	17
Inner Terai	69	10	6	48	64	58	8
Outer Terai	37	92	8	38	68	42	1
Highland River Valley	68	1	6	48	87	72	30

The variation in socio-demographic indicators from East to West is summarized in Table 8. The adult literacy rate is slightly higher in the East than in the West, the percentage of terai origin households is slightly higher in the West than in the East. The SES of the households in the East appears to be relatively better than in the West.

Table 8. East-West Variation in Socio-economic and Demographic Indicators

Region	Adult Literacy Rate in Percentage	Percentage of Households of Terai Origin	Household Size	SES		
				Low	*Medium*	*High*
East	59	36	6	25	47	28
West	53	43	7	28	50	23

1.8. Potential bed net risks and their variation across household groups

In the baseline survey, nearly 73% of households were found to have at least one bed net. This means about 27% of households are at a potential risk of vector bite by having no bed nets. Those who had bed net are also at a potential risk of vector bite by being unable to protect every household member from vector bite. To analyze this problem another risk factor seems to be essential to define using the collected information on the number of bed net users among those households who had bed nets. Accordingly, a household is defined as a *partial bed net user* if the household has at least one bed net and the number of bed net users in the household is less than the household size. The survey data show that about 37% of households are partial bed net users. This means about 37% of households who had at least one bed net are at a risk of vector bite by not being able to protect every member.

The two risks—percentage of households with no bed nets (Risk 1) and percentage of households having bed nets but not enough to protect all members (Risk 2)—are not uniform across the regions. Risk 1 is highest in the HRV followed by IT, OT and FF (Table 9). Risk 2 is highest in OT followed by the HRV, IT and FF (Table 9).

Table 9. Variation in Risk 1 and Risk 2 by Eco-region

	Forest Fringe	Inner Terai	Outer Terai	Highland River Valley
Risk 1	23	28	24	64
Risk 2	26	28	53	40

The two risks are also not uniform from East to West. Both risks are higher in the West than in the East (Table 10).

Table 10. Variation in Risk 1 and Risk 2 from East to West

	East	West
Risk 1	18	31
Risk 2	30	42

The percent of households with Risk 1 is almost uniform between terai and hill origin households (Table 11). On the contrary, the percentage of households with Risk 2 is nearly twice as high among terai origin households compared to hill origin households (Table 11).

Table 11. Variation in Risk 1 and Risk 2 between Terai and Hill Origin Households

	Terai Group	Hill Group
Risk 1	24	25
Risk 2	48	27

1.9. Association of potential bed net risks with SES and household size

As mentioned earlier this is just an illustration to show how risk factors are associated with socio-demographic variables. The two bed net risks are strongly associated with the variable SES. The risks decrease with the increase in the level of SES (Table 12). Risk 1 decreases faster than Risk 2 as level of SES increases. Risk 1 for instance decreases from about 41% to 9%, while Risk 2 decreases from about 44% to 31%.

Table 12. Association of Risk 1 and Risk 2 with SES

	Low SES	Medium SES	High SES
Risk 1	41	24	9
Risk 2	44	38	31

The two risks are also associated with the variable household size. But their nature of association with household size is different. Risk 1, for instance, increases with the increase in the household size reaching its maximum value when the household size is six, and then the risk tends to decrease with the increase in the household size (Figure 1). On the contrary, Risk 2 continues to increase with the increase in the household size. This explains why the terai group households are at greater risk of having some household members unprotected. The reason why the percentage not owning a bed net increases with household size up to a household size of six and then decreases is not clear. This may reflect a relationship with SES, families above a certain size being wealthier. Alternatively, this might reflect family make-up, with very large families being composed of extended families rather than reflecting larger numbers of children.

Figure 1: Association of the Percentage of No Bed Net User

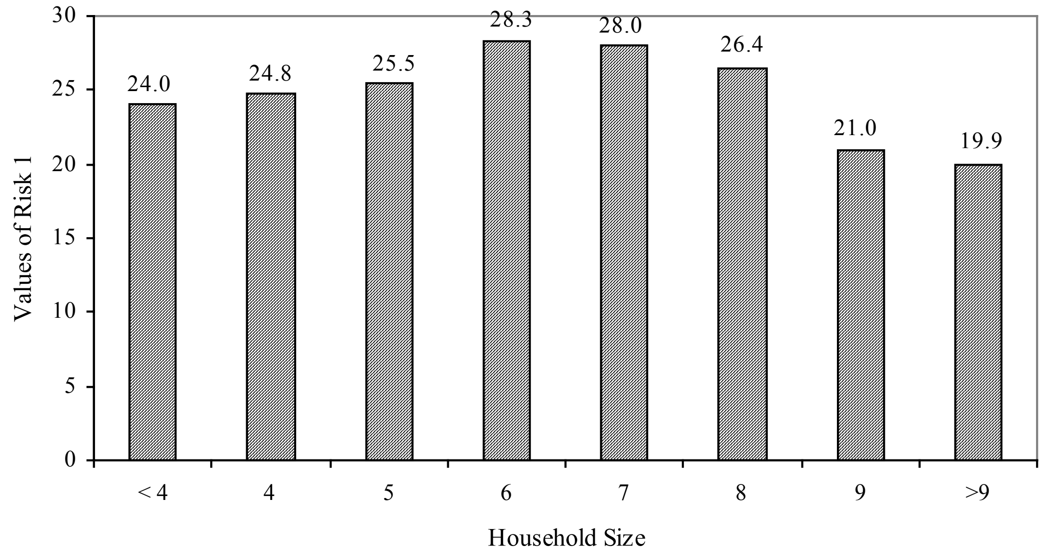
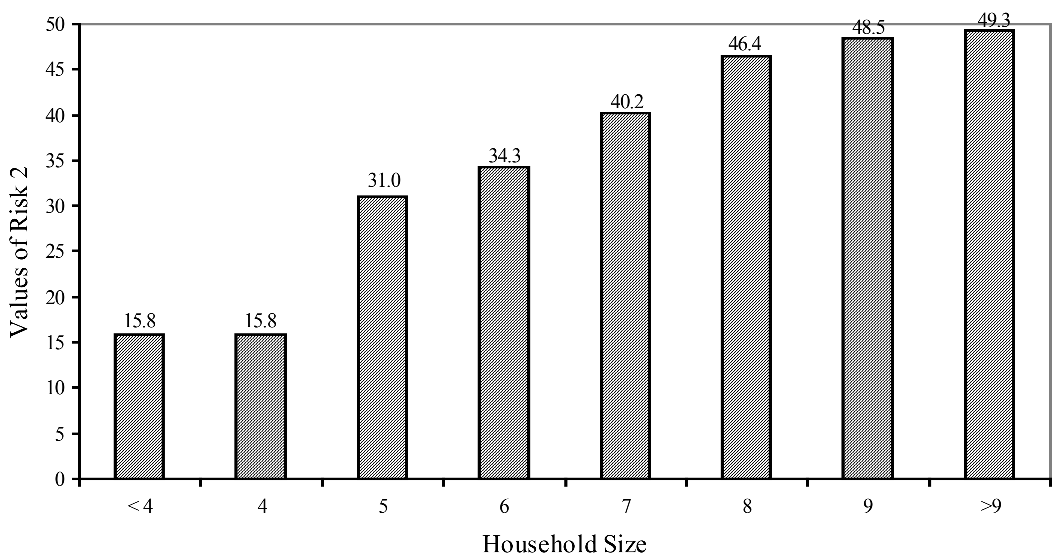


Figure 2: Association of Percentage of Partial Bed Net User



2. An Analysis of Baseline Survey Data on Malaria: What Can We Learn About Making Interventions More Effective?

2.1. Introduction

Historically, the lowland terai area of Nepal bordering on India was minimally inhabited because of malaria. Furthermore, the presence of malaria altered settlement patterns, with movement from the less endemic hills to the terai in the winter. Malaria remained widely endemic throughout Nepal in the terai prior to the insecticide-based malaria control program from 1958–1978. Following that program, and with reduction in prevalence, population growth in the terai accelerated dramatically. Today, the majority of the population of Nepal resides in the terai, with over 10 million residents there compared to nine million in the hills and under two million in the mountain regions (DHS Annual Report, 1997/98).

The government estimates that the vast majority of terai residents live in malaria-risk areas, and as many as half of those residing in the hills remain at risk, placing an estimated 16 million people at risk. As an integrated component of health services, surveillance is done through blood slide collection, and indoor residual spraying along with case management remain the primary interventions. There has been a more recent emphasis on identification of focal epidemics with a focused response. Slide collection has decreased over the years, and currently less than 175,000 slides are examined each year through government facilities. Over the past few years the annual blood examination rate has decreased, while slide positivity has increased (from 4.5% in 1995/96 to 6.2% in 1997/98). A total of 8,145 positive cases were reported in 1997/98 through the government integrated health information system. Spraying covered an estimated 147,000 people in the fall and 193,000 people in the summer during 1997/98 representing under 20% of the at-risk population.

In 2000, an analysis of the sensitivity of malaria surveillance in Nepal was carried out with assistance from the Centers for Disease Control and Prevention (CDC). This report noted the declining slide testing, increasing slide positivity, and tracked a sample of identified cases to health facilities. Of the illnesses identified, less than 10% were recorded at the health facility. Among those receiving treatment, only 12% of febrile illnesses were reported, and only 21% of slide positive cases were reported. Nearly half of febrile patients did not seek treatment, and 38% sought treatment outside the government health infrastructure. Case definitions at different facilities varied considerably. The study concluded that the number of malaria cases reported through the current system most likely does not reflect the true number of cases, and that malaria occurrence may be focal, sporadic outbreaks at least in the terai.

Malaria causes an acute febrile illness in non-immune populations, with clinical expression changing with repeated exposure, and for different types of malaria. All forms of malaria involve destruction of red cells and subsequent anemia, which can be severe. Fever, headache and cyclic fever are classic symptoms, particularly for plasmodium vivax, originally the most common species of malaria. Plasmodium falciparum can be more severe, with "pernicious" attacks that can cause kidney destruction and cerebral involvement. Treatment involves a variety of anti-parasitic drugs and is becoming more complex as resistance to these drugs increases and the ratio of falciparum malaria (which develops resistance easily) increases. Diagnosis is with examination of blood slides to confirm and identify the parasite. Since parasitemia varies dramatically during the clinical episode, slide examination may miss positive cases.

As with JE and KA, risk factors mostly involve the vector and vector dynamics. The anopheles vector is widespread in the lowlands of Nepal, with an accepted but not confirmed belief that the disease is far less common at altitudes above 4,500 feet. Since many river systems in Nepal remain at lower elevations even well into mountainous areas, malaria risk is not just restricted to the plains. Humans are the intermediate host, and the mosquito the definitive host, with most species biting principally in the evening hours. Unlike KA, there is no animal reservoir or amplification, although livestock attract the vector and thus may increase exposure to humans.

Known risk factors for malaria include presence of vector breeding sites, increased attraction of vector (from livestock), failure to use bed nets and other risky sleeping behavior, travel to endemic areas, and, to a certain degree, presence of other cases in the family or community. Specific recent case-control studies on malaria risk factors in Nepal have not been done.

2.2. Overview of the baseline survey for malaria

Sampling

Two additional districts were surveyed for malaria, as the disease is known to have spread to highland river ecosystems. Thus for malaria there were four districts in the East and four in the West, representing four different ecologic regions.

Ecologic Region	Eastern Districts	Western Districts
Outer Terai	Sarlahi	Kapilvastu
Forest Fringe	Jhapa	Kanchanpur
Inner Terai	Chitwan	Surkhet
Highland River	Dhankuta	Baitadi

A similar sampling frame was completed for MA, with a total of 300 households sampled for each district, half pre-monsoon, and half post-monsoon. One post-monsoon sample was not completed, leaving a total sample size of 2,100 households. Entomologic sampling was done for a total of 252 households. Blood slide data were collected on 7,273 individuals in 1,047 households, with only one suspected case identified.

Sociologic variables include a similar variety of household indicators as for JE and KA, including economic indicators, questions on knowledge and awareness of MAL, questions on different behaviors that may increase risk for MAL, and specific prevention and health seeking behaviors.

Recognized potential risk factors

General discussion of risk factors for MAL prior to analysis resulted in a priority listing of factors that could be examined with the baseline survey:

Risk Factor	Potential Hypotheses to Test in Baseline Survey
• Absence of any preventive measures • Presence of favorable ecologic zone • Absence of use of bed net • Absence of history of spraying • Lack of proximity or availability of treatment facilities • Lack of knowledge/awareness of disease transmission • Presence of vector • Presence of vector breeding sites • Presence of increased population movement • Presence of infection in family member or community	• Bed net use differs by geographic region, socio-economic status, and ethnicity • Risk factor for MAL (and other VBDs) differ among groups with different literacy and disease awareness rates, and across different ethnic groups • Families with a history of movement (Bihar/Assam) are more likely to have a family history of a case of MAL • Families with a history of bed net use are more likely to have increased awareness, fewer family cases, and a higher likelihood of having cases treated

2.3. Vector-based analysis

As with JE and KA, vector data collection was done in the same areas as the main socio-behavioral data, but in fewer households overall. Vector data was collected on adult vectors and for larva. The entomologic survey team collected information from 18 households from the three selected Village Development Committees (VDCs) for each district in both the pre- and post-monsoon seasons, for a total of 36 households per district, or a total of 288 households. From each household, the survey team spent 15 minutes collecting inside the house (indoor human dwelling or IHD), 15 minutes in the animal shed (AS) and 30 minutes outside (outdoor human shelter or OHS).

Vector data was not collected for the post-monsoon season for the highland river valley districts, and some households were missed. For MAL, data were collected from a total of 245 households, with more sampled in the pre-monsoon season. Captured adult vectors were categorized by species, with *Fluviatilis* the principal vector for MAL, and *Annularis*, and *Pseudowillmori* as additional species. Most analysis was done only for the principal vector.

The entomologic and socio-behavioral datasets were linked for households in which data were collected by each survey team. For MAL, a total of 241 households were linked. Of these, 61 (25%) had the vector present either pre- or post-monsoon or both, with most present in the animal shed.

Table 14. Captured Adult Vectors

	IHD	AS	OHS
Post Monsoon	10	18	11
Pre Monsoon	12	29	16
In Both Seasons	22	37	27

The vector was not equally distributed geographically, although this survey does not represent a comprehensive vector prevalence survey. Most vector positive houses were in Surkhet or Baitadi, with more vector positive households in the West, and fewer in FF. Sixty-three percent of HRV households had the vector present, compared to only 3% of FF households.

Table 15. Regional Variations of MAL Vector Presence at Domestic Site Across Eco-regions

Eco-region	**Vector Presence**		**Total**
	Yes	**No**	
Forest Fringe	2 (3%)	70 (97%)	72 (100%)
Inner Terai	26 (40%)	39 (60%)	65 (100%)
Outer Terai	11 (16%)	58 (84%)	69 (100%)
Highland River	22 (63%)	13 (37%)	35 (100%)
Total	**61 (25%)**	**180 (75%)**	**241 (100%)**

Data were collected on vector density for the principal vector only, for the different collection sites. Vector density was defined as the number of principal vectors captured during a time period divided by that time period, and this was calculated for each collection site. The time period was defined as person/hour of collection (0.25 x 6 for indoor and animal shed, and 0.5 x 6 for outdoor site). In addition, the ratio between the principal vector (Fluviatilis) and the total of Fluviatilis and Annularis (the most abundant vectors found) was calculated. As with KA, there were some differences in the proportion of all vectors that were the principal vector in different geographic areas.

Table 16. Vector Density

Eco-region	East/West	District	Vector Presence Status (Principal Vector)			
			Yes	No	Total	% Principal Vector
Outer Terai	East	Sarlahi	6 (18%)	27	33	73%
	West	Kapilvastu	5 (14%)	31	36	4%
Forest Fringe	East	Jhapa	1 (3%)	35	36	7%
	West	Kanchanpur	1 (3%)	35	36	5%
Inner Terai	East	Chitwan	2 (7%)	27	29	89%
	West	Surkhet	24 (67%)	12	36	68%
Highland River	East	Dhankuta	8 (47%)	9	17	41%
	West	Baitadi	14 (78%)	4	18	87%
		Total	**61 (25%)**	**180**	**241**	**51%**

For MAL, vector density was highest in animal sheds in both seasons. Vector density was also higher in the East during post-monsoon season, while slightly higher in the West during pre-monsoon. The percentage of principal vector was highest in Sarlahi, Chitwan and Surkhet (terai districts) and in both highland river districts compared to the rest, with Kapilvastu, Jhapa and Kanchanpur showing a strikingly lower percentage.

Vector presence was also associated with ethnicity, as measured by being of hill or terai origin. Among hill origin households, 33% were vector positive, compared to 11% among terai origin households. Also, there were slightly more vector positive households among those owning cows compared to those without cows, but otherwise no significant differences for other potential risk factors.

Very few larvae were collected, making further analysis of larva data limited. Of the 36 larva vectors collected, 27 (75%) were collected in the pre-monsoon season. Most (16/36 or 44%) were collected in riverbed pools.

2.4. Intervention-based analysis

Table 17. Malaria Descriptive Variables

	Total	By Eco-region			
	(n=2100)	Outer Terai	Forest Fringe	Inner Terai	Highland River
% Literate	56%	45%	59%	62%	64%
% of Low SES	26%	23%	19%	25%	46%
% Working in Agriculture	65%	60%	68%	68%	62%
% Owning Radio	51%	66%	47%	38%	41%

A similar list of priority interventions for MAL has been identified by the MoH as for JE and KA. These include: spraying for focal outbreaks, use of impregnated bed nets, improved case identification and treatment, improved surveillance to identify epidemic foci, and increased awareness and understanding of the disease. These general interventions can again be reviewed in the context of the baseline survey data by organizing them into different categories of interventions, and exploring the specifics of the interventions in more detail.

A. General information, education and communication interventions

Possible Intervention	Expected Outcome
• General disease awareness campaign • Campaign to increase community case identification and reporting and to improve case management • Educational campaign directed toward specific areas of chronic high risk, and toward areas with epidemic foci • Focused education campaign on specific risk factors	• Increased awareness of disease and its transmission • Increased triggering of targeted interventions and improved case management • Increased understanding among high risk communities • Increased community and household awareness of specific risk factors

Of the three vector-borne diseases under consideration, malaria is far and away the most common, with the highest awareness among the risk population. Furthermore, there is a long history of different interventions designed to reduce malaria risk, and these have not been completely successful. This may have resulted in some positive behavior changes over the years, but also may have caused a certain amount of fatalism about the ability to rid malaria from risk communities. In contrast to JE and KA, the higher level of awareness changes the kind of interventions needed to modify behaviors, but may make it easier to improve surveillance for epidemic outbreaks above the normal endemic level of disease.

Out of the full sample of 2,100 respondents, 1,609 or 77% said they were aware of MAL—a sharp contrast to the limited awareness of JE and KA. In spite of this high awareness, those of higher SES and those literate remained more likely to be aware. (85% of literate respondents were aware vs. 66% of illiterate respondents). A slight effect was seen with radio ownership.

Table 18. Awareness of Malaria

	Total	***By Eco-region***			
		Outer Terai	**Forest Fringe**	**Inner Terai**	**Highland River**
% Aware of Disease (n=2100)	**77%**	72%	81%	79%	72%
% Knowing of Transmission by Mosquitoes (n=1609)	**62%**	57%	64%	60%	72%
% Knowing Stagnant Water as Breeding Site (n=1140)	**45%**	28%	51%	67%	46%
% Knowing of Blood Test (n=1609)	**53%**	52%	56%	52%	47%

Also in contrast to JE and KA, awareness of malaria was much more equally distributed across ecologic regions, as might be expected with such high awareness generally. Residents of the FF and IT were slightly more likely to be aware (81% and 79% vs. 72% for OT and HRV eco-regions). This mild difference did not appear to be due to differences in SES or literacy status. No one district stood out with regard to awareness, with slightly higher awareness in Jhapa, Chitwan and Baitadi compared to the other districts, and with the lowest awareness (59%) in Dhankuta, which had similar literacy but lower SES. Awareness was slightly higher among hill origin respondents (80%) compared to terai origin respondents (70%). There was no difference in awareness between residents of the East compared to those in the West (78% vs. 75%). Thus the pattern of awareness is much more homogeneous geographically, making it difficult to highlight higher risk geographic areas based on awareness alone.

There was a similar pattern regarding sources of information among those aware of malaria as for JE and KA: 45% cited relatives and friends, 30% from seeing a case, 22% from a health worker, and under 15% from radio and poster information. While there were no differences in this pattern for different eco-regions for family and friends or seeing a case as the source of awareness, there were slight differences for other sources. The OT respondents cited posters, radio/TV less frequently, and health workers slightly more frequently than other eco-regions. More in the East cited relatives and friends (51% vs. 41%) and more in the West cited health workers (26% vs. 20%), but other sources were similar from East to West. These patterns do not suggest clear association of awareness with presence of the disease in communities, as it did for KA.

Having a family case of malaria was reported in 533 of the 2,100 respondents (25%). Since blood smears are not always done for definitive diagnosis, and since fever may commonly be assumed to be malaria in endemic areas, this may be an overestimate of actual malaria cases. However, if this potential overestimation is consistent across the country, then further exploration is useful. More respondents reported family cases in Jhapa, Surkhet and Kapilvastu (31%, 37% and 30% respectively) than other districts (24% for Sarlahi, 17% for Chitwan, 20% for Kanchanpur and Dhankuta, and 26% for Baitadi). This pattern did not fall distinctly into different eco-region or East/West differences, although slightly more in the West and fewer in the FF noted a family case. Thus, as with awareness, there is no distinct segregation of respondents with regard to a history of possible family case, even though there were more of these family cases to explore than for JE or KA.

General understanding of malaria was good. Sixty percent cited fever as a sign, and 53% noted everyday chill, sweating and fever. Most stated summer as the high season (80%), and the majority knew that a blood test detected the disease (53%), usually at a health institution (49%). Fully 62% noted mosquitoes as the means of transmission, compared to 4% for dirty environment, 1% for other insects or microorganisms, and 7% living with a malaria patient. There appeared to be some understanding of mosquito breeding sites, with the highest percent of respondents noting "dirty places" (50%) and stagnant water (45%) as places mosquitoes lay their eggs. Means of protection was equally divided (with multiple answers accepted), between bed nets (43%), taking medicine (40%), clearing the environment (48%) and spraying (24%).

Comparing the three districts with slightly higher awareness against the rest, there were no differences in understanding of symptoms, slightly more noting summer as the high season (83% vs. 78%), and fewer cited blood test as a means to detect malaria (49% vs. 55%). More in the higher awareness districts noted mosquitoes as transmission agents (63% vs. 61%), more said you could protect yourself (86% vs. 83%), and this was reflected in increased understanding of using a bed net or clearing the environment as protective measures (40% vs. 34% and 46% vs. 37% respectively). Thus although the differences are slight, it appears that higher awareness of malaria does translate to greater understanding of the disease—more people are aware and understand more about the dynamics of the disease than for JE or KA.

Nearly everyone knew that malaria could be fatal (87%), and that it could be treated (96%). The source of treatment was overwhelming from health workers (98%), with neither private clinics nor pharmacists significant sources of care (<2% each). However, only 8% could identify the name of the medicine to use for treatment. These remained consistent between more aware versus less aware districts. This reasonably high level of understanding of the disease suggests that the disease is prominent enough throughout the country for people to have learned quite a bit about it.

Implications for interventions

- Unlike KA and JE, awareness of MAL is high, and is relatively equally distributed across geographic and ethnic groupings

- Awareness did not seem to suggest greater familiarity with disease, and thus did not appear to identify high risk areas

- The data do not suggest a pattern useful for targeting interventions for endemic malaria, though this may be different for an outbreak (epidemic) situation

- Most respondents had reasonable understanding of the disease, its transmission, and case management (though most don't know the name of the appropriate medicine for treatment)

B. Behavior change interventions

• Educational campaign to reduce risk sleeping behavior such lack of bed net use • Educational campaign to improve household and community environmental risk reduction • Educational campaign to improve disease recognition, reporting and case management • Educational campaign to increasing reason for bed net use, need for re-impregnating net, and for full family coverage—as part of broader VBD effort	• Increased bed net use • Reduction in potential breeding sites, reduction in environmental attractors for vector • More accurate disease recognition, self-diagnosis and referral; improved case management and reporting; increased triggering of focused educational efforts • Improved bed net use and family member coverage

Behavioral interventions for malaria are challenging, in part because a great deal has been done, and the disease continues to be a serious problem. As with JE and KA, the vector is attracted to livestock, although unlike JE, there is no amplifier. The vector appears to be present throughout the terai, FF, IT, and is perhaps extending its range into river valleys. It is perhaps in part the efficiency of the vector and susceptibility of the human host that has contributed to the high prevalence of malaria.

Bed net use is quite high, and it has been difficult because of convenience and cost to improve the percentage of nets that are regularly impregnated with insecticide. Spraying is a passive exercise from the household perspective, and this activity is not universally done in all risk areas. Reduction in breeding sites and attractive habitat near houses require active household and community participation. Case recognition and management can be improved, but there is limited understanding about diagnosis and treatment, and resistance has developed rapidly. The recent evaluation of malaria surveillance suggests that this area can be improved, but this requires significant efforts throughout the health infrastructure. Thus, while KA and JE have some specific features that may suggest different intervention approaches, for malaria it is difficult to know what new interventions or improvements in current interventions will be most effective.

Behavior change to reduce risk sleeping

Table 20. Behavior Related to Malaria

	Total	By Eco-region			
		Outer Terai	Forest Fringe	Inner Terai	Highland River
% Stating Use of Bed Nets (n=2100)	**70%**	78%	76%	74%	36%
% With All Members Using Bed Net (n=1500)	**41%**	35%	54%	51%	21%
% Noting Clearing Environment as Prevention (n=1351)	**48%**	32%	52%	51%	61%
% With Family Case (n=2100)	**25%**	26%	26%	26%	23%
% With Family Case Going to HF (n=2100)	**93%**	92%	95%	90%	94%

As with JE and KA respondents, bed net use was high. Seventy percent cited bed net as the means of protection, and only 30% said they did not have a bed net. Among those with bed nets, there was a correlation between number of single and double bed nets owned and household size (r=0.78). Exploring whether many household members were left unprotected, the stated number of users was subtracted from household size. Similar to KA, 59% had at least one household member unprotected, with a mean of 3.2 unprotected members. There was a significant regional variation in the percent of households with at least one household member unprotected. Both Dhankuta and Baitadi had high percentages (75% and 82% respectively) compared to the lowest of 29% for Jhapa. This translated to a high percentage for residents of highland river valley eco-regions (79%) compared to the OT (65%) and less than 50% for FF and IT. The highland river eco-region had a mean of 4.4 members unprotected compared to a mean of 2.6 for the FF eco-region. Very few (4%) stated they used bed nets for health reasons.

Table 21. Behaviors Related to Awareness of Malaria

	Total	Among Those Aware	Among Those Not Aware
% Stating Use of Bed Net (n=2100)	**70%**	75%	56%
% With All Members Using Bed Net (n=1500)	**41%**	45%	29%

Awareness influenced bed net use behavior. Among those aware of malaria, 75% said they used bed nets to protect themselves from mosquitoes, compared to 56% of those not aware. Similarly, 55% of those aware had at least one household member unprotected compared to 71% of those not aware of malaria. Furthermore, 97% of those who said they used bed nets “for health reasons” were among those who were aware. Thus even with high awareness, improved awareness is related to improved behaviors to reduce risk.

Behavior change to reduce environmental risk factors

With the malaria questionnaire, few questions were asked about specific environmental risks around the household or for the community. Of the various means to protect from malaria, the highest percentage (48%) listed clearing the environment. In addition, 73% felt that people living near the forest get malaria, with most (65%) feeling that it was possible to get malaria during any season. As noted above, 45% noted stagnant water as a breeding site. Additional questions on how this relatively high level of awareness might translate to household activities to reduce risk would be of interest.

Implications for interventions

- Although bed net use is high, the percentage of households with someone left unprotected is higher in the highland river valley eco-region, suggesting that a targeted intervention to increase total bed net coverage may be appropriate for these regions

- Although awareness was high, risk-sleeping was higher among those not aware, suggesting that improving awareness in this group can reduce disease risk

- There was reasonable understanding of environmental risk factors, but this survey did not provide understanding of whether behavior change could reduce these risks

C. Environmental interventions

• Targeted household spraying triggered to outbreak • Community level campaign to reduce breeding sites	• Improved epidemic containment • Reduction in vector density at community level

As with KA, spraying is one environmental intervention currently implemented by the government. Only 85 respondents (4%) said their houses had been sprayed within the past 12 months. Of these, most (94%) said the entire house was sprayed. Nearly half (47%) plastered or painted their house afterward, 85% of whom did so within three months—some (20%) because of a festival, some (23%) because of the bad smell, and some (25%) as a regular household activity. Fifty-eight of the sprayed households were in the East (68%), and 45 (53%) in the FF ecosystem. Three districts (Jhapa, Sarlahi and Kanchanpur) accounted for 81% of the sprayed households. Jhapa, Surkhet and Kanchanpur had the highest spray rates for KA, suggesting that at least two of these districts had more active spraying programs.

Implications for interventions

- Many felt spraying would not prevent malaria, and few respondents reported spraying, mostly because no one came

- Respondents receiving spraying commonly plastered or painted their houses within a few months

- Spraying did not seem to be a highly prized intervention, with somewhat mixed attitudes to its role for malaria.

D. Capacity building interventions

• Establishment of community-based surveillance system to identify epidemic phases • Health staff (all levels) training on case recognition and management • Health facility training on linking reported data to intervention strategies	• Rapid response to focal outbreaks • Improved disease understanding and treatment; improved reporting • Increased targeted interventions begun

Malaria has been endemic in the lowlands of Nepal for several decades. Many in the risk areas may have had repeated episodes of malaria, which may alter the presentation of the disease, and may allow them to be reservoirs of infection for longer periods. Improved case recognition and management could make treatment more effective, with higher coverage among the infected population. Superimposed on this endemic situation is the risk of focal outbreaks, which carry high mortality, particularly in pregnant women. Rapid identification of these focal epidemics may reduce the total number of new cases. For these reasons, issues of case recognition, early and accurate reporting of incidence above the normal level, and adequate case management, may be important interventions. The baseline survey data provide some perspective on the current situation.

As noted above, awareness was high for malaria, with most people identifying several key symptoms. It is not clear whether identification beyond fever truly identifies a malarial episode, since only 31% identified alternate fever (which may not be present, particularly with falciparum malaria), and 12% fever then sweating. Only 5% of respondents aware of malaria (n=1609) noted two or more symptoms. Among those citing blood test as a means to detect malaria, 27% cited health workers as a source of awareness about malaria, compared to only 18% of those not citing blood test. Similarly, among those who knew that mosquitoes transmit malaria, 25% cited health workers as a source of awareness compared to only 19% of those who did not know of mosquito transmission. These data suggest that disease recognition and understanding improve when health workers are included as sources of information.

Most recognized that malaria was a potentially fatal disease (87%), but 7% thought it was not curable, and as with KA, 22% agreed that malaria could be treated with herbs. While only 5% said malaria patients should consult traditional healers, and

98% mentioned health workers as someone who could treat malaria, only 15% agreed that health workers provide good service for malaria. And yet, among those reporting a family case (n=533), 90% said the health worker made the diagnosis, and nearly all went to the health worker or health facility for treatment, and most reported that they complied with the full course of treatment. Nearly half (42%) felt malaria control was the responsibility of the government only, yet 42% thought that spraying insecticide does not prevent malaria. Thus, similar to JE and KA, most saw an important role for the government services, many had used those services, but there is limited confidence in those services.

Just over half of the respondents reported leaving the village within the past 12 months. Thirty percent reported visits to India, although there was not a particularly prominent state. The remainder reported moving between the hills and the terai. Among those mentioning that they had a family case, 59% said they had traveled compared to 41% of those without a family case. Among those traveling to India either in winter or summer, 30% reported having had a family case, compared to only 25% of those not having traveled to India. This suggests that travel, particularly to India, may contribute to increased cases, and this may have implications for surveillance.

The survey data do not provide information on community recognition of higher than normal incidence of presumed malaria. It would be interesting in further qualitative work to explore this further, since rapid response to outbreaks may be an important intervention in the future.

Implications for interventions

- Understanding about disease management is better when health workers are a source of information, suggesting that if health workers were to be more active educators, case management might improve

- Although most felt the government has responsibility for controlling malaria, confidence in preventive and clinical services was low. However, among those with cases, use of facilities and compliance with recommendations was high. This suggests that improvements in service delivery and changes in community trust of those services should result in improved use of and compliance with treatment regimens

2.5. Clinical analysis

As with JE and KA, a sub-set of households was selected for collection of thick and thin blood smears to identify current infection. Too few smears were positive to allow further analysis. Detection of parasites in blood smears is not easy and is commonly not positive even with clinical diseases. In endemic areas, it is common practice to self-diagnose and treat fevers for malaria, and taking an anti-malarial drug dramatically reduces the likelihood of finding the parasite on a thick or thin smear.

3. An Analysis of Baseline Survey Data on Kala-azar: What Can We Learn About Making Interventions More Effective?

3.1. Introduction

Kala-azar (KA), or visceral leishmaniasis has a long history in Nepal. As with malaria, KA is suspected of being widely endemic in the terai prior to the insecticide-based malaria control program in the 1960s. More recently, following large epidemics of KA in Bihar, India, the number of cases reported has been increasing annually, with a gross estimate of at least 2,000 cases per year.

KA is a chronic, systemic disease with a high fatality rate among untreated cases. The disease causes fever, weight loss, hepato and splenomegaly, and ultimately suppression of bone marrow with resultant immuno-compromise. Conclusive diagnosis may require identification of the parasite in the spleen or bone marrow, requiring invasive procedures not commonly done in Nepal. Two currently available serologic tests can identify exposed patients. The direct agglutination test (DAT) is reasonably sensitive and specific for patients with a classic presentation, but positivity may last for many years. Enzyme-linked serologic tests (such as the K39 antigen ELISA) may be useful as a confirmatory diagnostic test but is expensive and not fully tested. Case management in Nepal is not optimal, and it is common for patients to travel to India for treatment. Case treatment is currently free in Nepal but involves a long course of drugs and visits to often distant health facilities.

Risk factors for KA relate to exposure to the known sand fly vector in Nepal, *Phlebotomus argentipes*, which may breed in mud and dung. Transmission is from person to person without an amplifier host as with JE. However, sandflies feed on and are thus attracted to livestock. The limited number of studies on risk factors suggests household clustering of cases and a predominant risk from exposure to others with sub-clinical disease. Some studies have suggested that neither proximity to livestock nor presence of the vector were strong risk factors in and of themselves.

Recent work in Nepal includes a case-control study of KA risk factors done by Tribhuvan University, B.P. Koirala Institute of Health Sciences, and the VBDRTC, in conjunction with the Centers for Disease Control and Prevention. This study reviewed 92 cases of KA matched to 113 controls, and explored a variety of potential risk factors. Older children and young adults were most affected with a slightly higher rate in males. Both the K39 and DAT serologic tests were positive in over 90% of cases, whether the cases were clinical or with parasitologic confirmation. For both tests, however, positivity persisted for months after a treatment cure.

In this study, most cases had limited awareness about the disease or its currently free treatment. The study identified new disease clusters, suggesting that neither surveillance nor treatment is adequately reaching the population at large. The study confirmed other research suggesting that risk is higher among the poor and illiterate. Behavioral risks included risk-sleeping such as sleeping on the floor, sleeping on the ground floor rather than the first floor, and sleeping without a bed net. Environmental risks include having a damp floor and having cracks in house walls. However, there was not a risk associated with proximity to livestock, and in fact ownership of a cow or buffalo was strongly protective, even when adjusted for socio-economic status.

3.2. Overview of the baseline survey for KA

Sampling

As with JE, a total of six districts were surveyed, three in the East and three in the West, representing three ecologic regions.

Ecologic Region	**Eastern Districts**	**Western Districts**
Outer Terai	Sarlahi	Kapilvastu
Forest Fringe	Jhapa	Kanchanpur
Inner Terai	Chitwan	Surkhet

A similar sampling frame was completed for KA, with a total of 300 households sampled for each district, half pre-monsoon, and half post-monsoon, for a total sample size again, of 1,800 households. Entomologic sampling was done for a total of 208 households. Serologic data was collected on 4,272 individuals in 907 households, with only 11 suspected cases identified using the K39 or DAT serologic tests.

Sociologic variables include a variety of household economic indicators, questions on knowledge and awareness of KA, questions on different behaviors that may increase risk for KA, environmental questions concerning known and suspected risk factors, and specific prevention and health seeking behaviors.

Recognized potential risk factors

General discussion of risk factors for KA prior to analysis resulted in a priority listing of factors that could be examined with the baseline survey:

Risk Factor	Potential Hypotheses to Test in Baseline Survey
• Presence of single story house • Presence of mud walls and presence of cracks in walls • Presence of floor likely to be damp • Sleeping on floor, ground floor, or outside • Lack of ownership of cow or buffalo • Lack of regular use of bed net • Clustered settlement • Presence of vector or vector breeding sites • Presence of high vector density • Positive titer in family member or community • Presence of animal sheds adjoining house	• Geographic factors are strong determinants to KA risk factors • Vector bionomics differ from East to West reflecting differences in historical prevalence • There are significant differences in aggregate risk factors from East to West • Those with a history of case in family and/or increased awareness of disease are more likely to have a combination of risk factors • There is a relationship between vector presence and density and increased awareness of disease and history of family case of disease

3.3. Vector-based analysis

Vector data collection was done in the same areas as the main socio-behavioral data, but in fewer households overall. Vector data was collected on adult vectors (and for larva for JE and MAL). The entomologic survey team collected information from 18 households from three selected VDCs for each district in both the pre- and post-monsoon seasons, for a total of 36 households per district, or a total of 216 households. From each household, the survey team spent 15 minutes collecting inside the house (indoor human dwelling or IHD), 15 minutes in the animal shed (AS) and 30 minutes outside (outdoor human shelter or OHS).

For KA, data were collected from a total of 208 households, equally divided pre- and post-monsoon. Captured adult vectors were categorized by species, with *Argentipes* the principal vector for KA, and *Papatasi* the second species. Most analysis was done only for the principal vector.

The entomologic and socio-behavioral datasets were linked for households in which data were collected by each survey team. For KA, a total of 207 households were linked. Of these, 60 (29%) had the vector present either pre- or post-monsoon or both, with most present in the animal shed or inside the house.

Table 22. Presence of Vectors

	IHD	AS	OHS
Post-monsoon	15	13	4
Pre-monsoon	15	26	7
In Both Seasons	30	39	11

The vector was not equally distributed geographically, although this survey does not represent a comprehensive vector prevalence survey. Most vector positive houses were in the OT or IT, with somewhat higher percentages of houses with the vector present in the West. This contrasts with reported cases: while reported cases are mostly in the terai, most are in the East. There were some differences by KA species that are interesting and which may reflect some competition between species for the ecologic niche. Reviewing the ratio between the principal vector (Argentipes) and total vectors found, this ratio was highest in Chitwan and Surkhet (IT districts) compared to Sarlahi and Kapilvastu (OT districts).

Table 23. Ratio of Total Vectors and Vectors Found

Eco-region	East/West	District	Vector Presence Status			
			Yes	No	Total	Principal Vector (%)
Outer Terai	East	Sarlahi	11 (31%)	24	**35**	30%
	West	Kapilvastu	18 (51%)	17	**35**	30%
Forest Fringe	East	Jhapa	0 (0%)	36	**36**	67%
	West	Kanchanpur	3 (8%)	33	**36**	12%
Inner Terai	East	Chitwan	5 (17%)	24	**29**	100%
	West	Surkhet	23 (64%)	13	**36**	97%
		Total	**60 (29%)**	**147**	**207**	**46%**

Data were collected on vector density for the different collection sites. Vector density was defined as the number of principal vectors captured during a time period divided by that time period, and this was calculated for each collection site. The time period was defined as person/hour of collection (0.25 x 6 for indoor and animal shed, and 0.5 x 6 for outdoor site). For KA, vector density was highest in animal sheds in both seasons for Argentipes species, and highest in indoor collection for Papatasi species.

Analyzing patterns for the principal vector (Argentipes) only, density was highest in animal sheds for most regions, and highest in the pre-monsoon season for most regions. The highest indoor vector density was in Chitwan and Surkhet (IT) for pre-monsoon, and Surkhet and Kapilvastu for post-monsoon. Vector density was zero for Jhapa in both seasons, and very low for Kanchanpur. Reviewing density data by VDC, it is possible to calculate the percentage of VDC collection sites with density >1. (Each district had collection in three VDCs, with data collected at three sites for each VDC.) During pre-monsoon, only Surkhet had over 50% of VDC sites with vector densities >1, and in post-monsoon, only Kapilvastu. Thus vector density patterns differ, but there is no clear pattern that fits with reported KA cases.

Vector presence was also associated with several risk factors. Among households in which someone slept only on the floor, 53% were vector positive, compared to less than 31% of households in which members slept only on a cot or bed. Presence of a damp mud floor has been correlated with higher risk of KA.

Table 24. Association Between KA Vector Presence at Domestic Site and Sleeping Behavior of Household Members

Sleeping Behavior	Vector Presence		Total
	Yes	No	
Only on Floor	9 (53%)	8 (47%)	**17 (100%)**
Only on Cot	45 (31%)	102 (69%)	**147 (100%)**
Total	**54 (33%)**	**110 (67%)**	**164 (100%)**

Similarly, among households stating that animals were present in the sleeping area, 48% were vector positive compared to 27% of households without this practice. Among households with animal sheds near the house, 37% were vector positive, compared to 23% of those with their shed far away. Since ownership of a cow or buffalo may in fact be protective because the vector tends to prefer animals, the significance of these findings is not clear.

Table 25. Association Between KA Vector Presence Status at Domestic Site and Presence/Absence of Animals in Sleeping Room

Presence/Absence of Animal in Sleeping Room	Vector Presence Status		Total
	Yes	No	
Presence	14 (48%)	15 (52%)	**29 (100%)**
Absence	45 (27%)	125 (74%)	**170 (100%)**
Total	59 (30%)	140 (70%)	**199 (100%)**

Chi-square value = 5.6, $p = 0.017$

More households among those of terai origin were vector positive (40%) than among those of hill origin (21%), although this reflects the higher number of vector positive households in the terai, and the very high proportion of terai origin households there.

3.4. Intervention-based analysis

A similar list of priority interventions for KA has been identified by the MoH as for JE and malaria. These include: behavior modification, environmental interventions, spraying for focal outbreaks, use of impregnated bed nets, and improved case identification and treatment. These general interventions can be reviewed in the context of the baseline survey data by organizing them into different categories of interventions, and exploring the specifics of the interventions in more detail.

Table 26. Kala-azar Descriptive Variables

	Total	By Eco-region		
	N=1800	Outer Terai	Forest Fringe	Inner Terai
% Literate	**33%**	27%	44%	29%
% of Low SES	**22%**	25%	20%	22%
% Working in Agriculture	**45%**	44%	55%	36%
% Owning Radio	**47%**	31%	51%	60%

A. General information, education and communication interventions

Possible Intervention	Expected Outcome
• General disease awareness campaign • Campaign to increase community case identification • Educational campaign directed toward specific target groups, or to specific geographic areas • Focused education campaign on specific risk factors	• Increased awareness of disease and its transmission • Increased triggering of targeted interventions and case management • Increased understanding among target group • Increased community and household awareness of specific risk factors

For KA, the general education campaign has a somewhat expanded focus over JE. First, it may improve understanding about the disease, its presentation, and the importance of early case management (including availability of free treatment). Second, an awareness campaign has the potential to sensitize communities to KA, increasing reporting, and thus increasing a responsive intervention plan designed to target areas with new cases.

Table 27. Awareness of Kala-azar

	Total	By Eco-region		
		Outer Terai	Forest Fringe	Inner Terai
% Aware of Disease (n=1800)	**14%**	27%	10%	6%
% Knowing of Transmission by Sandflies (n=199)	**14%**	7%	30%	9%
% Knowing of Abdominal Distension as Sign (n=254)	**15%**	14%	24%	6%
% Knowing of Free Treatment (n=254)	**25%**	28%	24%	11%

Out of the full sample of 1,800 respondents, only 254 or 14% said they were aware of KA—a lower figure than for JE, and far lower than for MAL. As with the JE sample, awareness increased with increasing socio-economic status, literacy, and radio ownership.

There were some striking differences from JE in the pattern of awareness and geographic region. While nearly half of FF residents were aware of JE (more than OT or IT), the reverse was true for KA. Twenty-seven percent of OT residents were aware of KA compared to 10% of FF and only 6% of IT residents. Awareness was much higher in the East (22%) compared to the West (7%). These differences appear to be mostly related to the very high awareness in one district, Sarlahi, with 54% of all those aware residing in this district, and with nearly four times as many residents of Sarlahi aware than residents of other districts (43% vs. 10%).

As with JE, this difference cannot be explained by differences in socio-economic status, which were similar for the three eco-regions, nor by literacy status, which is lower for OT residents (and lowest in Sarlahi) but similar for FF and IT residents. While the majority of OT residents were of terai origin (91%) compared to less than 25% for other eco-regions, awareness was more equally distributed, with 19% of terai origin respondents aware compared to 11% of hill origin respondents.

This evidence, combined with similar findings for JE, suggests that awareness is related to the presence of the disease in communities, and that those most aware may also be those most at risk. Further analysis helps to clarify this point.

Nearly half (49%) of those aware (n=254) reported family or friends as the source of their awareness, and 21% reported seeing a patient as the source. Only 17% reported the radio, 11% posters, and 15% a health worker as the source. This again suggests that awareness is from familiarity with the disease rather than learning of KA from other sources. Although awareness was higher in the OT, only 6% reported radio as their source of information on KA compared to 25% and 50% for residents of the FF or IT respectively.

Only 17 respondents of the full 1,800 questioned said they had experienced a family case of KA. Those family cases reported may not be KA, and there also is likely to be substantial underreporting. However, 71% of these reported family cases were in the OT, and 10 of the 17 were reported from Sarlahi. These findings suggest distinct clustering of disease and raise the potential for interventions focused on identifying a sentinel case to trigger further interventions directed at treatment and behavior change.

Table 28. Awareness of Kala-azar

	Total	By East/West	
		East	West
% Aware of Disease (n=1800)	**14%**	22%	7%
% Knowing of Transmission by Sandflies (n=199)	**14%**	9%	25%
% Knowing of Abdominal Distension as Sign (n=254)	**15%**	13%	20%
% Knowing of Free Treatment (n=254)	**25%**	27%	19%

Awareness of the disease or residence in a risk area did not necessarily translate to better understanding about the disease. There was no difference among those aware versus those not aware, of a variety of potential risk sleeping behaviors, for example. Among those aware (who were asked other questions about their awareness), understanding about the disease was not better in residents of areas where awareness was higher. While slightly more OT residents identified fever as a key symptom (69% vs. 63% for FF), fewer identified weight loss and weakness (21% vs. 32% for FF). Furthermore, only 7% of OT residents noted sandfly as the vector compared to 30% of FF residents and 9% of IT residents. These data suggest that awareness and familiarity with the presence of disease may not mean greater understanding of the disease.

With the high awareness in Sarlahi, the difference between eastern and western districts was also reviewed. Residents in the East were more aware (22%) compared to residents in the West (7%). Although nearly half of residents of both East and West mentioned family as a source of information, more western residents noted TV or radio as their source of information than in the East. Further understanding of the disease was not consistently better among eastern residents, as was true for different ecologic regions. The most striking difference was with understanding of the vector, with more eastern residents mentioning mosquito as the vector (36%) than sandfly (9%) compared to 20% and 25% respectively for western residents. This again suggests that although there appears to be greater familiarity with disease in the eastern OT, this has not translated to much greater understanding of the disease itself.

Regarding educational message development, awareness of KA is lowest among the three vector-borne diseases being reviewed, providing a relatively small number (n=254) who were asked further questions about their understanding. While 65% noted the common and very general symptom of fever, only 22% mentioned weight loss and weakness, and 15% abdominal distension. While most said people could die from KA (67%), only 54% said it could be prevented. Most (80%) felt KA could be treated, and most (55%) knew it took a long time to treat, but only 25% knew that treatment could be provided "free." Only 27% agreed that health workers provided good service for KA. Thus, in contrast to JE, even among those aware of KA, real understanding of the disease and its management is lacking, perhaps in part because it is a more rare occurrence in the community.

Implications for interventions

- Awareness for KA is very low, but as for JE appears to be associated with some familiarity with the disease

- Awareness does not impart understanding of the disease, even recognizing the sandfly as the vector, suggesting almost no understanding of potential risk factors

- As with JE, there appears to be clustering of indicators of familiarity with the disease in the East and in the OT, with one district (Sarlahi) standing out as highest risk

- Some aspects of disease risk and case management were vaguely understood (such as high mortality and long time for treatment), but few were aware of free treatment or had much confidence in health facility treatment

B. Behavior change interventions

• Educational campaign to reduce risk sleeping behavior such as sleeping on floor • Educational campaign to improve household and community environmental risk reduction • Educational campaign to improve disease recognition, reporting and case management • Education campaign to increasing reason for bed net use, need for re-impregnating net, and for full family coverage—as part of broader VBD effort	• Decreased sleeping on floor particularly on ground floor • Increased repair of household wall cracks, reduction in environmental attractors for vector • Increased disease recognition, self-diagnosis and referral; improved case management and reporting; increased triggering of focused educational efforts • Improved bed net use and family member coverage

Behavioral interventions for KA differ from those for other vector-borne diseases because of the nature of the vector, and the lack of proven efficacy among other common interventions. The vector is attracted to livestock, and known to breed in animal waste and in wall cracks, suggesting that some environmental behaviors could reduce risk. Spraying has been associated with reduction in prevalence, but it has been difficult to sustain such interventions. Higher risk is known to be associated with lower socio-economic status, but may be more strongly associated with presence of a family or community case or travel to a highly endemic area. While bed net use is likely to be protective, the vector is small, and may be able to get through the net.

The recent case-control study in Nepal (Bern et al, 1999) identified a number of behaviors associated with reduced risk. These included sleeping on a cot as opposed to sleeping on the ground, sleeping on the second floor, sleeping under a bed net, and not sleeping outside or on the ground. However, sleeping in proximity to domestic animals not only did not increase risk, but was actually protective. Measures of higher socio-economic status were protective, and both wall cracks and floor dampness were associated with higher risk. Summary multivariate analysis suggested that three or more rooms in the house, ownership of a cow or buffalo and bed net use were protective, while having a damp house floor increased risk.

Interventions designed to change risk behavior thus might focus on risk sleeping behavior and efforts to reduce environmental risk factors. The baseline dataset provides some insight into current behavior related to these potential interventions.

Behavior change to reduce risk sleeping

Of the 1,800 respondents, only 11% slept only on the floor. However, an additional 20% slept both on a cot and on the floor, leaving only 69% sleeping only on a cot. Most (59%) slept on the ground floor at least some of the time, leaving only 20% of respondents sleeping on the lower risk first floor. Nearly 6% were at the highest risk of sleeping only on the floor on the ground floor. Over half (55%) sleep outside in the open, and although only 19% do so all the time, 80% do so in the summer only, when vector density is likely to be high. Males were perhaps slightly more likely to sleep outside.

Table 29. Behavior Related to Kala-azar

	Total	By Eco-region		
		Outer Terai	Forest Fringe	Inner Terai
% Owning at Least One Bed Net (n=1800)	**76%**	76%	77%	74%
% With All Members Using Bed Net (n=1200)	**47%**	39%	56%	52%
% Sleeping Only on Floor (n=1800)	**11%**	13%	4%	16%
% Sleeping on Ground Floor (n=1800)	**59%**	82%	52%	42%
% w/ Family Case (n=1800)	**1%**	2%	1%	0%

Most households had at least one bed net (76%). Subtracting the stated number of bed net users from household size, however, 53% had at least one household member unprotected (n=1,200 respondents for "new" questionnaire). As with JE, most did not use bed nets for health reasons (only 3% did), and of those without bed nets, cost was the most important factor. Thus, while there is significant room for improvement with regard to avoiding sleeping on the ground or outside, it may be more difficult to alter the overall family use of bed nets.

Table 30. Behaviors Related to Awareness of Kala-azar

	Among Those Aware	Among Those Not Aware
% Owning at Least One Bed Net	84%	74%
% With All Members Using Bed Net (n=1200)	59%	45%
% Sleeping Only on Floor (n=1800)	9%	11%
% Repairing Rat Holes (n=1800)	84%	65%

Variations in risk sleeping behavior geographically were small. There were no significant differences in the percentage sleeping only on the ground, although far fewer slept on the first (upper) floor in the OT (8% compared to over 25% for FF and IT), and this difference persisted among different socio-economic groups. Among high SES, 11% of OT residents slept on the first floor compared to 26 and 19% of residents of FF and IT respectively. However, this reflects the fact that twice as many OT houses are single story. Only slightly more residents in the East slept only on the ground compared to western residents (12% vs. 10%), although more in the East slept on the first floor (22% vs. 18%). More in the East had bed nets (82% vs. 69%) and more in the East had all family members covered (54% vs. 42%) perhaps reflecting slightly higher literacy in the East (though no significant difference in SES).

Awareness of the disease had some affect on different risk behaviors. Only slightly fewer slept only on the floor among those aware (9% vs. 11%), and there was no difference in the percentage sleeping on the first floor or percentage sleeping outside. Of the 254 aware of KA, 84% had at least one bed net compared to 74% of the 1,545 that were not aware of KA. Furthermore, 59% had all family members covered in the aware group compared to only 45% among those not aware. This suggests that even simple improvement in awareness of KA may have some impact on risk behaviors.

Behavior change to reduce environmental risk factors

With the vast majority of households made of bamboo, wood and mud ("kaccha" 77%), having livestock (90%), and having animal waste near the house (84%), risks for vector breeding sites are high. Eighty-seven percent had mud plaster floors, and only 13% reported having no cracks in their walls. Most reported rat holes near the house (59%) and 71% had a granary inside the house.

As with sleeping behavior, behavior around environmental issues also had some, but limited geographic variation. Fewer had kaccha houses in the OT (68%) than the FF (89%), but a similar number as the IT (74%). There was no difference in livestock ownership (owning cow, buffalo, or goat) across eco-regions, and only a slight difference in having animal waste near the house. The OT had more households with mud floors and fewer with cement floors (93% and 6% respectively) compared to the FF (83% and 11%) and the IT (85% and 15%). More households in the OT had a granary and rat holes inside or near the house than other eco-regions (85% vs. 72% and 59% for granary; 96% vs. 85% for rat holes). Although literacy was much lower in the OT, SES was not, and these housing differences may reflect cultural practices based on the dramatic ethnic difference in terai versus hill origin. The vast majority of OT residents were of terai origin (91%) compared to far fewer in the FF (22%) and the IT (11%).

While ethnic origin may explain eco-region differences, there are additional differences from east to west, suggesting potential differences in risk. Terai versus hill origin were equally distributed from East to West, so ethnicity is less likely to explain these differences. There was a slight but significant increase in the percentage of kaccha houses in the East, but no difference in overall livestock ownership and only a very slight decrease in the percentage in the East with animal waste near the house, or with granaries inside the house. Significantly more households in the East had cement floors (14%) compared with the West (8%) and fewer had mud floors (82% vs. 92% in the West). However, more western households reported no wall cracks (15%) compared to eastern households (9%), and more eastern households reported rat holes near or inside the house. Thus there is a mixed picture of different environmental risk factors from east to west, with no clear weighing of higher risk in the East as might be expected from the significantly higher awareness there (22% aware in the East compared to 7% in the West).

There is some awareness of these environmental risks, although it is not clear whether this awareness is linked to motivation to address them. Among those aware of KA and who believe KA can be prevented (n=137), 64% mentioned cleaning the environment as a means of protection. More than half (59%) associate animals around the house as "sources of KA," and 57% agree that people who look after animals are more likely to get KA. Nearly 60% disagreed that spraying could not prevent KA.

In spite of this awareness of some environmental risk factors, and probably because of habit, cultural and economic considerations, behavior is not geared to reduction in risk. Among the full sample, those aware and not aware of KA, 15% had their animal shed attached to the house, and 19% had some domestic animals in the sleeping room. More of those who were aware of KA had attached animal sheds than those unaware (21% vs. 14%). Only 67% said they fixed rat holes in or near the house, and only 3% had had their houses sprayed within the past 12 months—nearly all because the spray man did not come. More among those aware of KA (n=254) repaired rat holes (84%) than among those not aware (65%), but there was no difference in whether the house had been sprayed or not.

Settlement patterns also may represent different conditions that might increase risk for KA. KA is known to cluster within families and is suspected to cluster within communities, with higher risk among neighbors of infected individuals. Thus it is logical to consider whether households are part of a clustered settlement as opposed to a more scattered community. Similarly, presence of foliage has been considered a risk factor for KA, and thus settlement near forests may increase risk.

Among the 1,800 respondents, 55% lived in clustered settlements, and 38% lived near or in the forest. These variables differed geographically: far more OT households were part of a clustered community (93%) compared to FF (30%) or IT (42%). However, far fewer OT households were in or near forest (11%) compared to FF (56%) or IT (47%). These potential risk factors appear to counter each other between different eco-regions. The picture changes somewhat for variation from East to West. There was no difference between east and west with regard to scattered versus clustered settlement. Fewer households were in or near a forest in the East (29%) than in the West (47%).

Awareness was significantly higher among those in clustered settlements (17%) compared to those in scattered settlements (10%), yet was also higher among those *not* living in or near the forest (16% vs. 11% of those living in or near forest). However, since awareness in Sarlahi district (Eastern OT) was so much higher than other districts, many of these differences are explained by Sarlahi's contribution: in the Sarlahi sample, 93% live in clustered housing with only 18% living in or near the forest.

Implications for interventions

- Most households exhibit some risk-sleeping behavior, but increased awareness of KA reduced this behavior
- Risk sleeping behavior was not dramatically different for different eco-regions or from East to West
- The vast majority of households had several environmental risk factors encouraging vector breeding
- Environmental risk factors did not clearly segregate from east to west or by eco-region as might be expected from the significant differences in awareness geographically
- Increased awareness influenced some risk factors, but not as clearly as with JE.

C. Environmental interventions

• Targeted household spraying triggered to outbreak • Community level campaign to reduce breeding sites	• Improved epidemic containment • Reduction in vector density at community level

Many of the environmental issues have been discussed above, as these relate to specific behaviors to reduce environmental risk. Other environmental interventions not specifically tied to household behavior may also be important. For KA, this is principally spraying, which is one of the interventions noted by the Ministry of Health for vector-borne diseases.

Very few respondents said their houses had been sprayed within the past 12 months. Among the 1,200 asked (the question was not included in the original questionnaire), only 38 (3%) said spraying had been done. With such a small number of households having been sprayed, further analysis is suspect, though this provides some information. Sprayed households were predominantly in scattered settlements (84%) compared to household not sprayed (46%), and mainly near the forest (87% vs. 35% of unsprayed households). Awareness of KA did not differ among sprayed versus unsprayed households. The vast majority of sprayed households were in the FF; three districts accounted for all but one sprayed household (Jhapa, Surkhet and Kanchanpur), with Jhapa accounting for 47% of sprayed households. With the vast majority saying that no one came to spray as the reason for not being sprayed, this suggests that Jhapa either had a better spraying program or greater reasons for spraying. However, among those asked about spraying there were only 10 family cases noted, and there were fewer in Jhapa than most other districts. A number of additional questions were asked of households that had been sprayed, but small numbers preclude meaningful analysis.

Implications for interventions

- There did not seem to be any pattern of spraying suggesting that it was done in higher risk areas

- Most felt the government had responsibility for management of KA, most appeared to favor spraying but noted that it just was not done.

D. Capacity building interventions

• Health staff (all levels) training on case recognition and management • Community level educational campaign for improving case recognition, surveillance and reporting • Health facility training on linking reported data to intervention strategies	• Improved disease understanding and treatment; improved reporting • Increased suspected cases reported • Increased targeted interventions begun

The baseline survey provides some information on attitudes and behavior related to case recognition and management. One potential way to strengthen interventions is to focus them on areas with highest risk. Since KA is a relatively rare disease, and since it tends to cluster, strengthened surveillance may be helpful in identifying these higher risk areas and could trigger focused interventions.

Clinical case management and community acceptance of health facilities varies dramatically from area to area and depends to a great degree on the motivation and skill of the health care providers. Improved case recognition and management and winning the confidence of communities served may be critical components for a vector-borne disease program. The survey data provide some insight into this dynamic.

As noted above, most people were not aware of KA, and of those who were (n=254), only 15% cited health workers as their source of information. Most felt KA could be treated (80%), and of these, 91% said health workers could treat the disease, though most did not know that free treatment was available (69%). Most did not feel that traditional healers should be consulted for long duration fevers (73%), though 21% felt KA could be treated with herbs. While 37% felt that KA control was only government responsibility, only 26% felt that health workers provided good service for KA. Clearly there is a perception of need from government service, but lack of full confidence in that service.

Community recognition of KA is limited. Only 7% identified four key symptoms (fever, weight loss, abdominal distension and "face turns black"), and 26% felt a KA patient should not be touched. Nearly 6% felt that KA was caused by an evil spirit, and 17% fully felt KA was not a curable disease. This lack of recognition of the disease is understandable in that few have likely seen a case. Whether community education could improve recognition is not clear, and yet if so, community reporting of possible cases could help target interventions. Further data are needed on the ability of health workers to recognize KA and the ability of the current surveillance system to capture cases and trigger a response.

Implications for interventions

- The clinical pattern of the disease was not understood, and most did not understand appropriate care-seeking

- Most wanted health facilities to manage cases, but few had full confidence in the health system, and very few knew of the free treatment program.

3.5. Clinical analysis

Along with the vector and socio-behavioral data collection, a sub-sample of clinical data was also collected. For KA, this consisted of collection of a blood sample from all members older than six months from selected households, analyzed using the direct agglutination (DAT) serologic test. The K39 antigen ELISA serologic test was used in Kapilvastu and Kanchanpur in post-monsoon period. DAT is highly specific and sensitive among those with characteristic clinical findings, but less so among asymptomatic individuals. The K39 test is considered to be more specific, but is more costly. It is known that seropositivity as measured by these tests remains positive for an extended period—often months after cure.

Households were selected from among those selected for the socio-behavioral survey. For each season, five VDC were selected from each district, five villages for each VDC, and three households within each village for a total of 75 households to be sampled for each district per season. This resulted in an expected sample of 900 households (6 districts x 150 HH.) Out of the total household members eligible for sampling (6,264) a total of 4,272 samples (68% of expected) from 907 households were collected.

Very few individuals were positive, with a total of 11 suspected cases, making further analysis difficult. Seven suspected cases were in the East, distributed across eco-regions.

Table 30. Summary of Clinical Data

Diagnosis	Number of Cases		Total
	Pre-monsoon	Post-monsoon	
Negative	2,149	2,112	**4,261**
Border Line	0	7	**7**
Positive	2	2	**4**
Total	**2,151**	**2,121**	**4,272**

Of these 11 cases or suspected cases, 10 were women, three were five years old or younger, and three were of high socio-economic status. There was no pattern for ethnicity, single or double story house, or type of house. Nine of the eleven suspected cases were from households with mud walls in the house, and eight were from households where members slept only on the ground floor. The small number of suspected cases, and lack of clear patterns, makes it difficult to relate these clinical findings with patterns of awareness or other risk variables.

4. An Analysis of Baseline Survey Data on Japanese Encephalitis: What Can We Learn About Making Interventions More Effective?

4.1. Introduction

Japanese encephalitis (JE) is a devastating disease of relatively low prevalence present in lowland parts of Nepal. The disease is transmitted by Culex mosquitoes, with wild birds and pigs the main amplifying hosts. Transmission usually does not occur from humans, as the period of viremia is brief. The disease is mostly a disease of children, with incidence estimated to be 40 per 100,000. Most infections are asymptomatic yet of those with serious disease, one third die, and one third have serious neurologic sequellae.

The disease is endemic in warmer climates, and epidemic in more northern environments probably because of temperature pattern differences. Data throughout Asia suggest that both the range and incidence of JE are expanding dramatically, with epidemics documented in Nepal beginning in the 1970s. A number of factors have been hypothesized for the spread of JE, including agricultural practices resulting in increased mosquito breeding sites and animal husbandry practices. Decline in incidence in developed countries has been generally attributed to spraying, altered pig-raising practices, separation of homes from breeding sites and amplifier hosts, improved housing in general, and mass vaccination of children. Vaccination programs have shown a shift in disease incidence to older children.

Clinical disease runs the spectrum from self-limited flu-like illness to headache, convulsions (in up to 85% of children) and neurologic findings. JE can present as a polio-like acute flaccid paralysis, complicating surveillance for both diseases. Definitive diagnosis is now done with enzyme linked immunosorbant assays, and a simple rapid IgM serologic test based on color change now exists.

While further information is needed on factors contributing to the spread of JE, preventive measures to date have not had a dramatic impact. Spraying and larvicide application to rice fields and swine vaccination have been tried without clear successes perhaps because of difficulty with broad application. Human vaccination is effective, with the Chinese live attenuated vaccine showing 80% efficacy for a single dose and 97% efficacy for two doses one year apart.

4.2. Overview of the baseline survey for JE

Sampling

A total of six districts were surveyed, three in the East and three in the West. Three ecologic regions are represented:

Ecologic Region	Eastern Districts	Western Districts
Outer Terai	Sarlahi	Kapilvastu
Forest Fringe	Jhapa	Kanchanpur
Inner Terai	Chitwan	Surkhet

A total of 300 households were completed for each district, half pre-monsoon, and half post-monsoon, for a total sample size of 1,800 households. Entomologic sampling was done for a total of 216 households. Serologic data was collected on 900 households, but the number of individuals with positive titers was too low to provide meaningful comparisons with non-positives.

Sociologic variables include a variety of household economic indicators, questions on knowledge and awareness of JE, questions on different behaviors that may increase risk for JE, and specific prevention and health seeking behaviors.

Recognized potential risk factors

General discussion of risk factors for JE prior to analysis resulted in a priority listing of factors that could be examined with the baseline survey:

Potential Risk Factor	Potential Hypotheses to Test in Baseline Survey
• Lack of awareness or knowledge of disease • Absence of any preventive measures • Absence of bed net use • Absence of history of insecticide spraying • Presence of risk sleeping behavior • Case history in family member or community • Presence of amplifier reservoir • Presence of correct vector species • Presence of ideal vector breeding sites • Larval density	• Presumed risk variables differ geographically. • There are differences in risk variables between pre- and post-monsoon periods. • There is a correlation between history of case and/or increased awareness, and vector variables (presence of breeding site, larval density). • Ethnic variation in risk factors suggests need for targeting interventions. • There are differences between JE and MAL with regard to the relationship between bed net use and history of a family case of disease.

4.3. Vector-based analysis

Vector data collection was done in a subset of households sampled for the socio-behavioral survey. Vector data were collected on both adult vectors and for larva. As with KA, the entomologic survey team collected information from 18 households from three selected VDCs for each district in both the pre- and post-monsoon seasons, for a total of 36 households per district, or a total of 216 households. From each household, the survey team spent 15 minutes collecting inside the house (indoor human dwelling or IHD), 15 minutes in the animal shed (AS) and 30 minutes outside (outdoor human shelter or OHS).

For JE, data were collected from a total of 213 households, equally divided pre- and post-monsoon. Captured adult vectors were categorized by species, with *Tritaeniorhynchus* the principal vector for JE, and *Pseudovishnu, Vishnu, Fuschocephalus and Glidus* also reviewed. Most analysis was done only for the principal vector, as with KA.

Table 31. Number Vector Positive HH

Forest Fringe	10 (42%)
Inner Terai	6 (25%)
Outer Terai	8 (33%)
Total	**24**

The entomologic and socio-behavioral datasets were linked for households in which data were collected by each survey team. For JE, only 24 of the 212 linked households had vectors present, limiting further analysis. Vector positive households were distributed across all three eco-regions, with somewhat more in the FF.

As with KA, there were some geographic differences by JE species that again suggest some competition for the ecologic niche. Reviewing the percentage of all JE vectors that are the principal vector (*Triataeniorhynchus*), this ratio was highest again in Chitwan and Surkhet (IT districts) compared to Sarlahi and Kapilvastu (OT districts).

Table 32. Total Vector vs. Principal Vector

Eco-region	East/West	District	Total Vector (#)	Principal Vector (%)
Outer Terai	East	Sarlahi	1	27%
	West	Kapilvastu	215	27%
Forest Fringe	East	Jhapa	26	0%
	West	Kanchanpur	156	15%
Inner Terai	East	Chitwan	282	100%
	West	Surkhet	26	98%
		Total	**706**	**45%**

Again, data were collected on vector density for the different collection sites. As with KA, vector density was defined as the number of principal vectors captured during a time period divided by that time period, and this was calculated for each collection site. The time period was defined as person/hour of collection (0.25 x 6 for indoor and animal shed, and 0.5 x 6 for outdoor site).

For JE, vector density in general was not high, making close examination difficult. Vector density tended to be lower in animal sheds in the East, and higher in the animal sheds in the West, for both pre- and post-monsoon collection. Vector density tended to be slightly higher in the East during pre-monsoon but tends to be higher in the West during post-monsoon.

The number of vector positive households was too small for much stratification regarding risk factors. There did not appear to be any difference in awareness between vector positive and vector negative households. More vector positive households were landless (17% vs. 11%), but there was no association with a history of family case. There were only 19 households in the linked dataset stating ownership of pigs. Of these, 21% were vector positive. Among the 24 vector positive households, 17% owned pigs compared to 15/188 (8%) of vector negative households, suggesting an association.

There were too few larva collected to allow further analysis. From all districts, only 17 larvae were collected, most during the post-monsoon season, with Surkhet and Kapilvastu having the most.

Table 33. Japanese Encephalitis Descriptive Variables

	Total	By Eco-region		
	n=1800	Outer Terai	Forest Fringe	Inner Terai
% Literate	56%	40%	61%	63%
% of Low SES	24%	26%	18%	28%
% Working in Agriculture	46%	59%	68%	63%
% Owning Radio	48%	27%	54%	64%

4.4. Intervention-based analysis

The Ministry of Health has identified priority interventions for JE, kala-azar and malaria. These include: behavior modification, environmental interventions, spraying for focal outbreaks, use of impregnated bed nets, vaccination for JE, and improved treatment. These general interventions can be reviewed in the context of the baseline survey data by organizing them into different categories of interventions, and exploring the specifics of the interventions in more detail.

A. General information, education and communication interventions

Possible Intervention	Expected Outcome
• General disease awareness campaign • Educational campaign directed toward specific target groups, or to specific geographic areas • Focused education campaign on specific risk factors	• Increased awareness of disease and its transmission • Increased understanding among target group • Increased community and household awareness of specific risk factors

A general education campaign has the potential to increase sensitivity to Japanese encephalitis, which could result in both individuals and communities taking steps to minimize their risk and improve the management of cases. The survey provides some insight.

Only 32% of respondents had heard of JE. This suggests that a general educational campaign could have an impact in improving understanding about JE, and measures to reduce risk. Awareness, as expected, increased with socio-economic status, literacy, and radio ownership.

Awareness differed for different ecologic regions, with only 18% of OT residents aware of JE compared to 48% of FF residents and 29% for IT residents. This difference cannot be fully explained by differences in socio-economic status, which were similar for the three eco-regions, nor by literacy status, which is lower for OT residents but similar for FF and IT residents. Awareness also differed from east to west, with 27% of residents in the East aware compared to 36% of residents of the West.

Table 34. Japanese Encephalitis Descriptive Variables

	Total	By Eco-region		
		Outer Terai	Forest Fringe	Inner Terai
% Awareness of Disease (n=1800)	**32%**	18%	48%	29%
% of Knowing Transmission by Mosquitoes (n=569)	**70%**	42%	77%	64%
% Knowing Association w/Pigs (n=569)	**89%**	75%	96%	86%
% Knowing It As a Diseases of Children (n=569)	**67%**	62%	75%	60%

Similarly, awareness differed by ethnicity, as measured by being of terai or hill origin, with 74% of those aware being of hill origin. Forty-one percent of hill origin respondents were aware of JE compared to only 19% of terai origin respondents. This difference persists regardless of eco-region of residence: among terai origin respondents, 15% of those living in the OT were aware of JE compared to 35% living in the FF and 20% living in the IT. Thus, regardless of socio-economic status or literacy, awareness was greater in the FF ecologic region, and among those of hill origin.

These findings raise questions with regard to educational initiatives: Should the focus be on *less* aware groups, or is increased awareness a sign of increased familiarity with JE, suggesting increased risk? This question cannot be fully answered given evidence that JE is expanding to new environments, but the baseline survey does provide some information.

Only 27 (1.5%) of the 1,800 respondents said there had been a family case of JE. Though some of these may not have in fact been JE, 24 of 27 went to the hospital, and 18 of the 27 were admitted, suggesting that the illness was serious. Hypothesizing that these were in fact JE cases, further analysis is interesting. Half of these cases were in FF residents, and 56% in those of hill origin. Twenty of these 27 (74%) were either resident of the FF, or were of hill origin.

Among those aware of JE (n=569), 20% reported hearing about JE from having seen a patient with JE, 34% from relatives and friends, and 44% from radio or TV. Among residents of the FF, twice as many (43% of FF residents vs. 24% of outer or IT) reported relatives or friends as the source of information, and 26% (compared to 26% of OT residents but only 8% of IT residents) reported seeing a JE patient. These data suggest, though not conclusively, that residence of the FF or ethnicity as a representation of those of hill origin, may represent the highest risk populations.

Questions on the understanding of the disease were asked only of those aware of the disease, and this information may be useful in the design of general education messages. Among the 569 respondents who were aware of JE, most (70%) knew it was transmitted by mosquito bites, and nearly all (90%) said people could die of JE. A surprising 67% noted that children were more likely to get JE, with the majority agreeing that fever, disability and mental retardation were associated with JE.

Most respondents aware of JE were aware of the association with pigs, with 89% agreeing that JE was common in pig farms. While 80% said you could protect yourself, 61% mentioned bed nets, 24% noted keeping away pigs, and only 9% mentioned vaccination. Although only 9% mentioned a dirty environment as a means of transmission, 76% mentioned clearing the environment as a way to protect themselves. It is interesting that knowledge about JE was higher for most of these variables among FF residents compared to outer or IT residents, with the exception of awareness of JE vaccine.

Regarding managing the disease, most felt that the disease could be treated, preferably by a health worker (95%). However, 53% felt that JE patients needed to be isolated, and only 23% felt that health workers provided good service for JE, perhaps reflecting the reality of the lack of curative treatment.

These findings suggest that once aware of the disease, general knowledge is reasonable, both for awareness of preventive measures, and realistic understanding of case management. The survey provides some additional insight about whether this reasonable knowledge translates to improved behaviors.

Implications for interventions

- General awareness can be improved and is likely to improve overall understanding of the disease

- General awareness is higher in the FF, in the West and among hill origin groups, suggesting that these represent higher risk and that interventions could be targeted.

B. Behavior change interventions

• Vaccination campaign triggered by outbreak	• Increased vaccination coverage in epidemic foci
• Education campaign to increase reason for bed net use, need for re-impregnating net, and for full family coverage	• Improved bed net use and family member coverage
• Educational campaign to reduce risk sleeping behavior	• Decreased sleeping on floor or near amplifier host
• Educational campaign to improve pig management practices	• Reduced housing of pigs or poultry in house or in proximity to sleeping areas
• Educational campaign to improve disease recognition, reporting and case management	• Increased self-diagnosis and referral; improved case management at health facilities

Behavioral interventions for JE are not simple, and none provide a magic solution for this disease. Vaccination is available and effective, but does not build herd immunity, and is unlikely to eliminate JE since the human host is a “dead end” host, and since both domestic and wild animal amplifiers exist. Bed nets can provide protection, but Culex bites at dusk and dawn when many people are outside. Poor pig management practices may increase risk, but in Nepal it is common practice to combine human and animal housing, and economic and land availability constraints make it difficult to change household structure. However, JE has been controlled in more developed settings, and improvement should be possible. The baseline survey again provides some insight into the behavioral practices of those in presumed endemic areas.

Table 35. Behavior Related Japanese Encephalitis

	Total	By Eco-region		
		Outer Terai	Forest Fringe	Inner Terai
% Knowing of Vaccine (n=569)	**14%**	19%	10%	19%
% With Any Family Member Vaccinated (n=1800)	**1%**	0%	0%	1%
% Stating Use of Bed Nets (n=1800)	**73%**	73%	80%	67%
% With All Members Using Bed Net	**48%**	38%	59%	47%
% Owning Pigs (n=1800)	**9%**	1%	18%	8%

Vaccination is little known and little used. Less than 1% of respondents said any family member had ever had JE vaccine, and this did not change among those saying there had been a JE case in the family. Among those aware of JE, less than 10% mentioned vaccination as a means of protection, and only 14% even knew about the vaccine. Among FF residents who were aware of JE, only 10% knew about JE vaccine, and only 6% mentioned vaccine as a means of protection. Among hill origin respondents, 13% knew of the vaccine, but only 9% mentioned vaccine as a means of protection. Thus, if vaccination is to be a component of the intervention strategy for JE, further education is needed to increase awareness and use of the vaccine, even among those who are most aware of the disease.

Bed net use is interesting and has been analyzed separately for the whole sample. However, for JE, there are some interesting patterns. Nearly three quarters (73%) reported using bed nets to protect against mosquito bites. However, only 5% mention using bed nets for health reasons. Even among those aware of JE or with a family history of a JE case, only 7% use bed nets for health reasons.

Bed net use improved with increased awareness: 85% use bed nets among those aware of JE compared to 68% among those not aware. Of those noting that mosquitoes transmitted JE, 87% used bed nets compared to only 81% among those not noting this transmission. Calculating whether there are household members not protected (by dividing household size by bed net users), 33% of those aware of JE had a household member remaining at risk, compared to 62% among those not aware of JE.

Among those stating that they did not have a bed net (n=313), the vast majority (87%) said it was because they could not afford it. Failure to have all household members protected was associated with both socio-economic status and literacy.

Thus bed net use is perhaps more widespread than expected, but few households have all members protected, and cost remains a significant factor for complete bed net protection.

Furthermore, bed nets appear to be used primarily to protect against bites rather than having a clear connection to disease prevention. Disease awareness does appear to have a small impact on bed net usage.

Presence of an amplifier host should be reflected in some of the socio-behavioral variables in the survey. While it is not possible to evaluate risk from wild bird hosts, questions were asked about poultry (including ducks as possible reservoirs), pigs (known reservoirs) and cattle. While 76% of respondents kept cattle, only 27% noted poultry, and 9% noted having pigs. Most respondents knew of the association of JE with pig farms, with 96% of FF residents agreeing with this association.

Table 36. Behaviors Related to Awareness of Japanese Encephalitis (n=1800)

	Among Those Aware	Among Those Not Aware
% With Any Family Member Vaccinated	1%	0%
% Stating Use of Bed Nets	85%	68%
% With All Members Using Bed Net (n=1200)	67%	38%
% Owning Pigs	10%	9%

Ownership of pigs differed across different ecologic regions, with 18% of FF residents owning pigs compared to 1% in the OT and 8% in the IT. Poultry ownership was also more common in FF and IT residents (39%) compared to OT (4%). Cattle and goats were more commonly owned than pigs or poultry in all eco-regions. Assuming that poultry might and pig ownership does represent risk, the highest risk group was the FF eco-region, with ownership of both higher in this group than others (11% for FF vs. <1% and 4% for OT and IT respectively). These relationships were not as strong for ethnicity.

Implications for interventions

- Awareness of vaccination is very low among all groups suggesting that if vaccines can become available, an awareness campaign could improve usage.

- While bed net use is high, protection for all household members can be improved, and may improve with increased awareness of the disease. Thus a more specific awareness focus is needed.

- The higher ownership of pigs and poultry in the FF again suggests higher risk, and may justify targeting community-based interventions to households of greatest risk in this eco-region.

C. Environmental interventions

• Targeted household spraying triggered to outbreak • Community level campaign to reduce breeding sites • Focused educational effort to separate livestock shelters from households	• Improved epidemic containment • Reduction in vector density at community level • Improved family compound building design

Environmental interventions for JE are in some ways similar to those for other VBDs, and relate to management of potential breeding sites, reduction in the suitability of habitat for the adult vector, and making household changes that reduce risk of exposure. Unlike malaria, JE is a relatively rare disease, suggesting that even in the presence of the vector, other conditions must be met before transmission is likely. The pattern of disease differs in different ecosystems, with temperature and rainfall influencing transmission. Furthermore, some evidence suggests that JE is expanding its domain, and this may be evidenced by different patterns of disease occurrence, with more sporadic outbreaks in distant areas. These aspects of JE make community-level or household level environmental interventions more difficult, since a great deal might be done with limited impact on a relatively rare occurrence. The questionnaire for JE included a limited number of questions that pertain to environmental interventions. These are briefly summarized below and reflect similar findings as for MAL.

With most recognizing that JE is transmitted by mosquitoes, it is not surprising that most also agreed that windows and doors should be screened. Furthermore, 84% disagreed that clean environment may not prevent JE, and over 90% agreed that the community had responsibility to keep the environment clean. Nearly all respondents aware of JE agreed that all houses should be sprayed with insecticides for JE (93%).

Implications for interventions

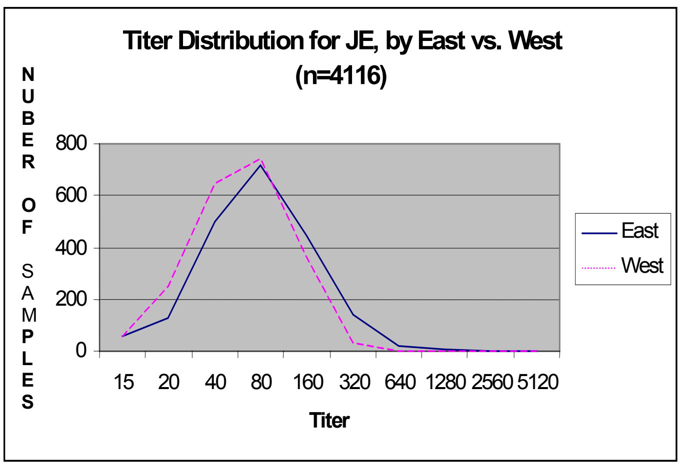
- Were it available, spraying would likely be accepted and perceived as beneficial.

- Communities may be able to be mobilized to perform some environmental activities to reduce risk if specific actions could be well defined.

D. Capacity building interventions

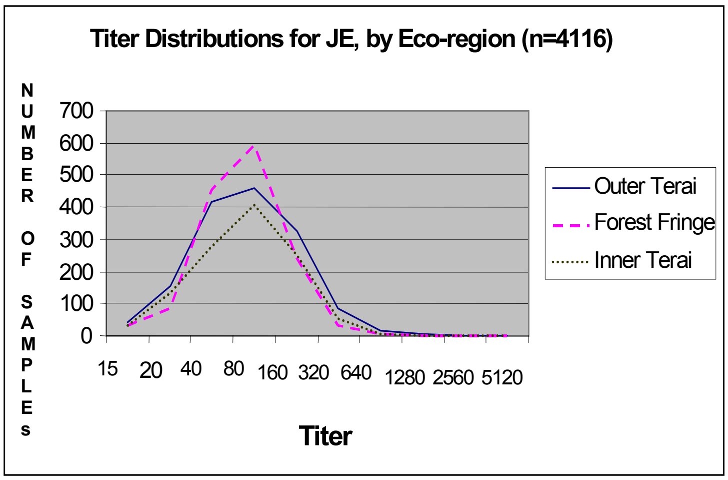
• Health staff (all levels) training on case recognition and management • Community level educational campaign for improving case recognition, surveillance and reporting • Health facility training on linking reported data to intervention strategies	• Improved disease understanding and treatment; improved reporting • Increased suspected cases reported • Increased targeted interventions begun

There were too few households saying they had had a family case to make further analysis about perceptions of case management significant. However, most of the noted cases went to hospital and were admitted. Among this small group, health workers were noted as the person saying the case was JE for 89% of cases, although just over half of cases said they "self-referred" to the hospital. As with KA and MAL, most felt that health facilities should manage JE, but few said the health workers provided good service.

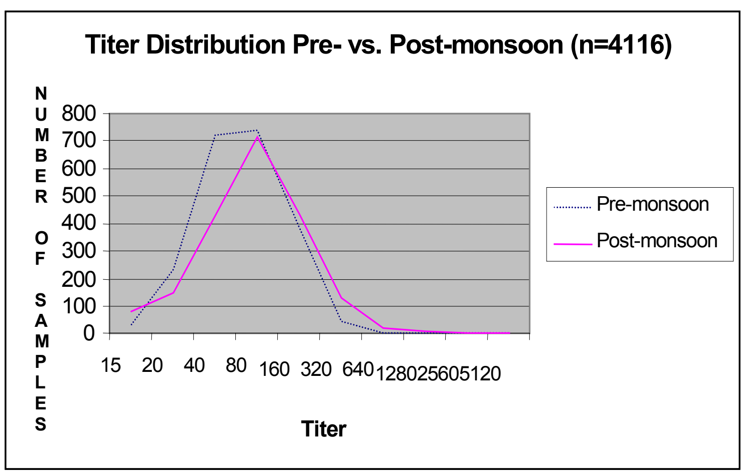


4.5. Clinical analysis

A total of 900 households were sampled for clinical analysis, divided equally between pre- and post-monsoon seasons. Sampling consisted of blood collection for serologic JE titer. Out of 6,492 eligible household members, 4,116 (63%) were sampled. A total of 201 (4.9%) individuals had JE titer greater than 160. These underwent IgM-ELISA analysis. Seventy-one percent of those with JE titers >160 had IgM-ELISA greater than one.



There was a shift in the distribution of titers between pre- and post-monsoon seasons with higher titers in the post-monsoon season. There was no difference in the percentage of titers >160 between males and females, and similarly, no significant difference in this percentage comparing those under 15 years old, those 15–60, and older. Among those in the East, 8% had titers >160 compared to only 2% of those in the West. Sarlahi and Chitwan had the highest percentages (12% and 8% respectively), with slightly higher percentages for the OT.



Clinical analysis does not provide much insight into the pattern of the disease, or further risk factors. The fact that there is not a dramatic difference in titer distribution between young and old may suggest that the disease is not firmly established in the population and thus has not resulted in the majority of adults having higher titers.

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Annex 1

The Vector-borne Disease Baseline Survey: What Was Done?

- Socio-behavioral household survey
- Entomologic survey with household and peri-household vector collection
- Clinical survey with blood collection
- The survey complements qualitative assessments and operational research

Socio-behavioral component

- Household characteristics (literacy, land ownership…)
- Disease awareness and attitudes questions (transmission, symptoms…)
- Behavioral questions (bed net use, livestock management…)

Entomologic component

- Adult vector and larva for MA and JE collected
- Indoor, animal shed, outdoor collection sites
- Main analysis on principal vector
- Vector distribution and density reviewed

Clinical component

- Blood smear for malaria
- Serology for JE
- DAT or K39 serologic test for KA

Baseline Survey (BLS) Sample Design

- Country divided into 4 ecoregions, and into East and West zone
- Purposive screening of districts then random selection of 1 to represent each ecoregion and zone
- Purposive screening of VDCs, then random selection of 10 VDCs
- Random selection of 5 villages > 30 households
- Random selection of 6 households per village

BLS Sample Size

VBD	Socio-behavioral	Entomologic (2 villages x 3 hh)	Clinical (50% subset)
Malaria dataset (8 dist)	2400 hh (2100)*	252 hh (245)*	1200 hh
JE dataset (6 dist)	1800 hh	216 hh (213)*	900 hh
KA dataset (6 dist)	1800 hh	216 hh (208)*	900 hh (907)*

* Actual number sampled

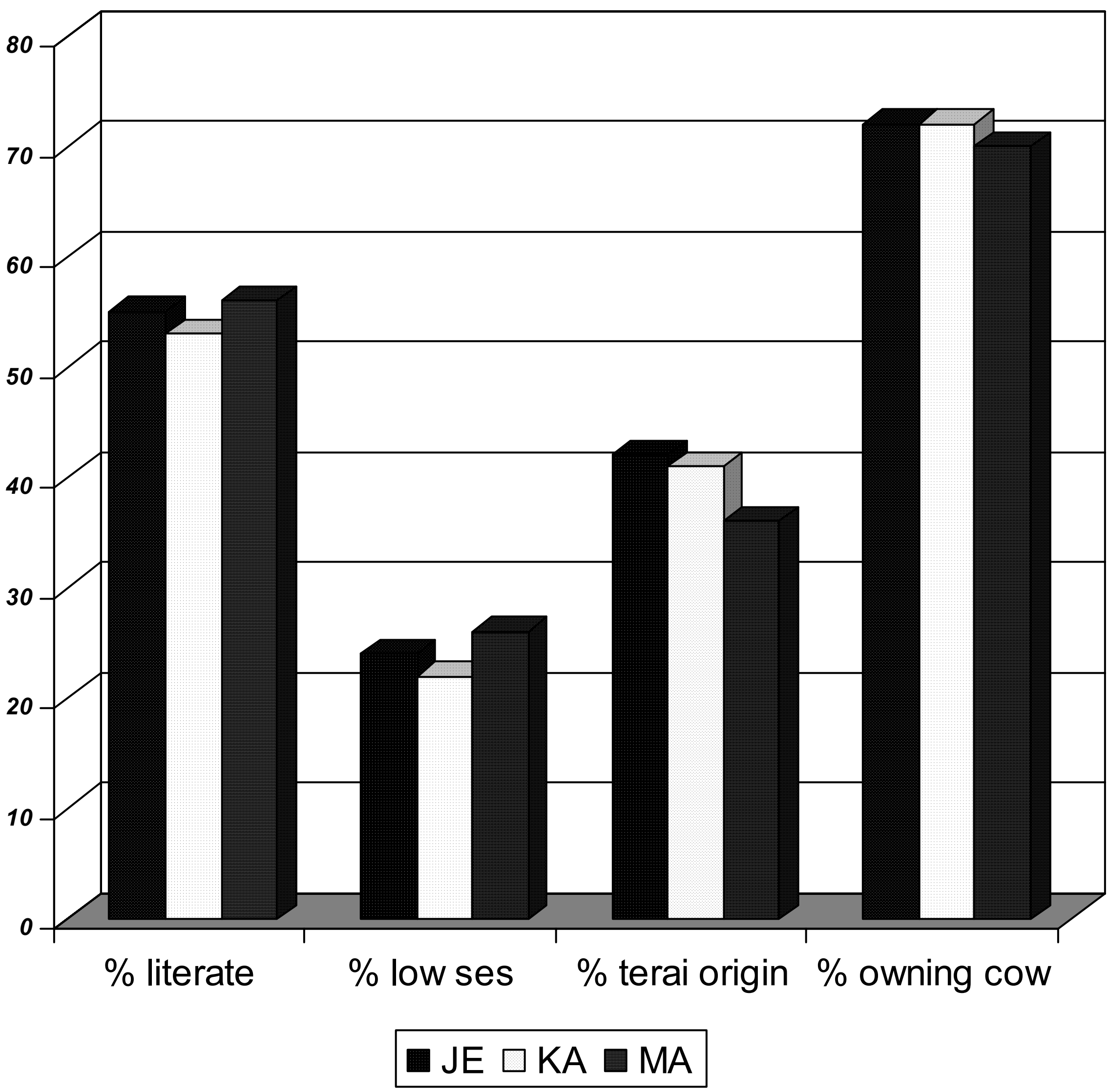
General Approach to Analysis

- Review variation across different groups
- Review geographic differences
- Review potential risk factors
- Look for patterns across the different datasets

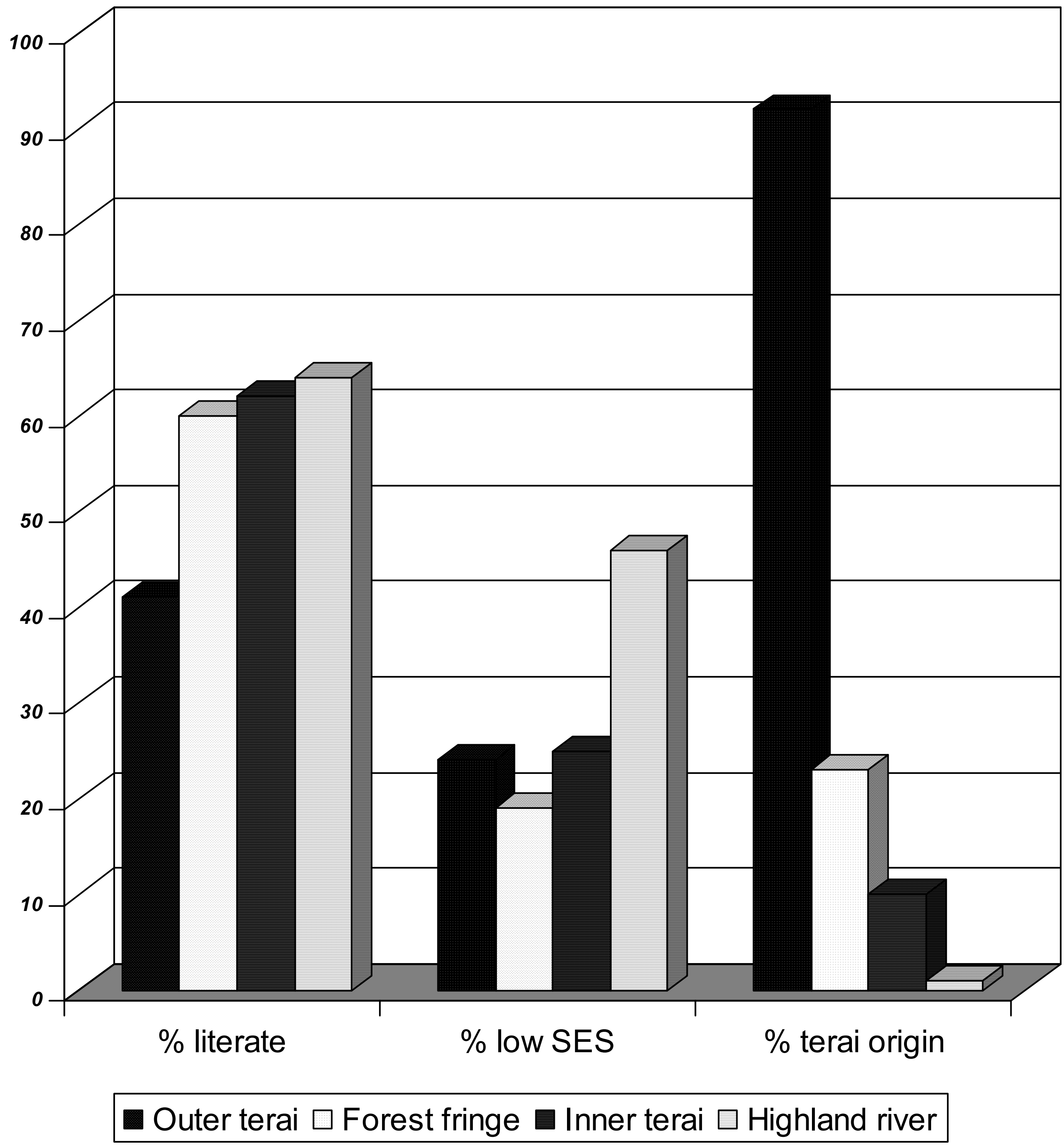
BLS: General Characteristics

Average household size	6.8
% of terai origin (as measure of ethnicity)	40%
% literate	55%
% of low socio-economic status	25%
% owning a cow	87%
% owning a radio	73%

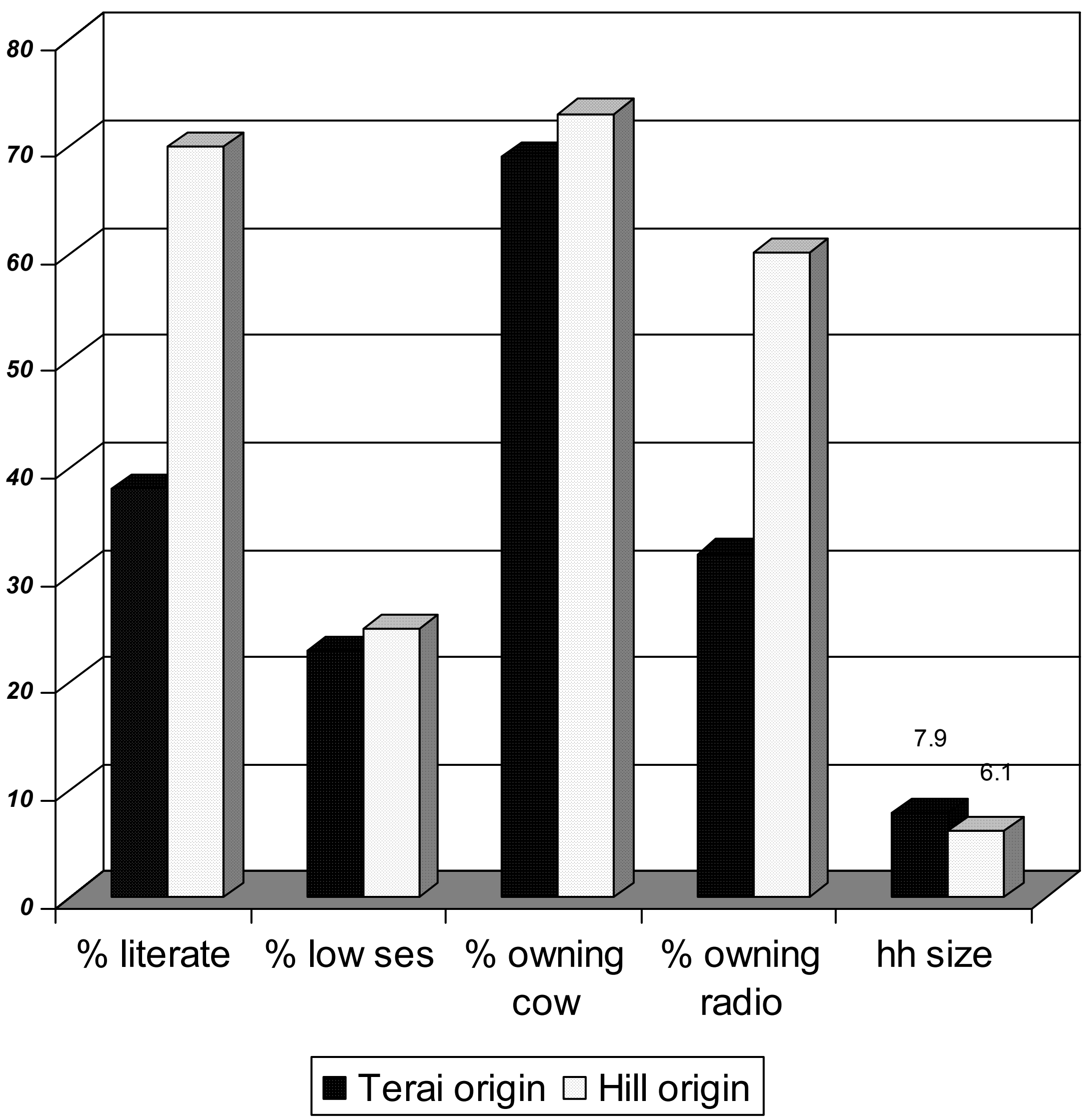
Variation by Disease Dataset



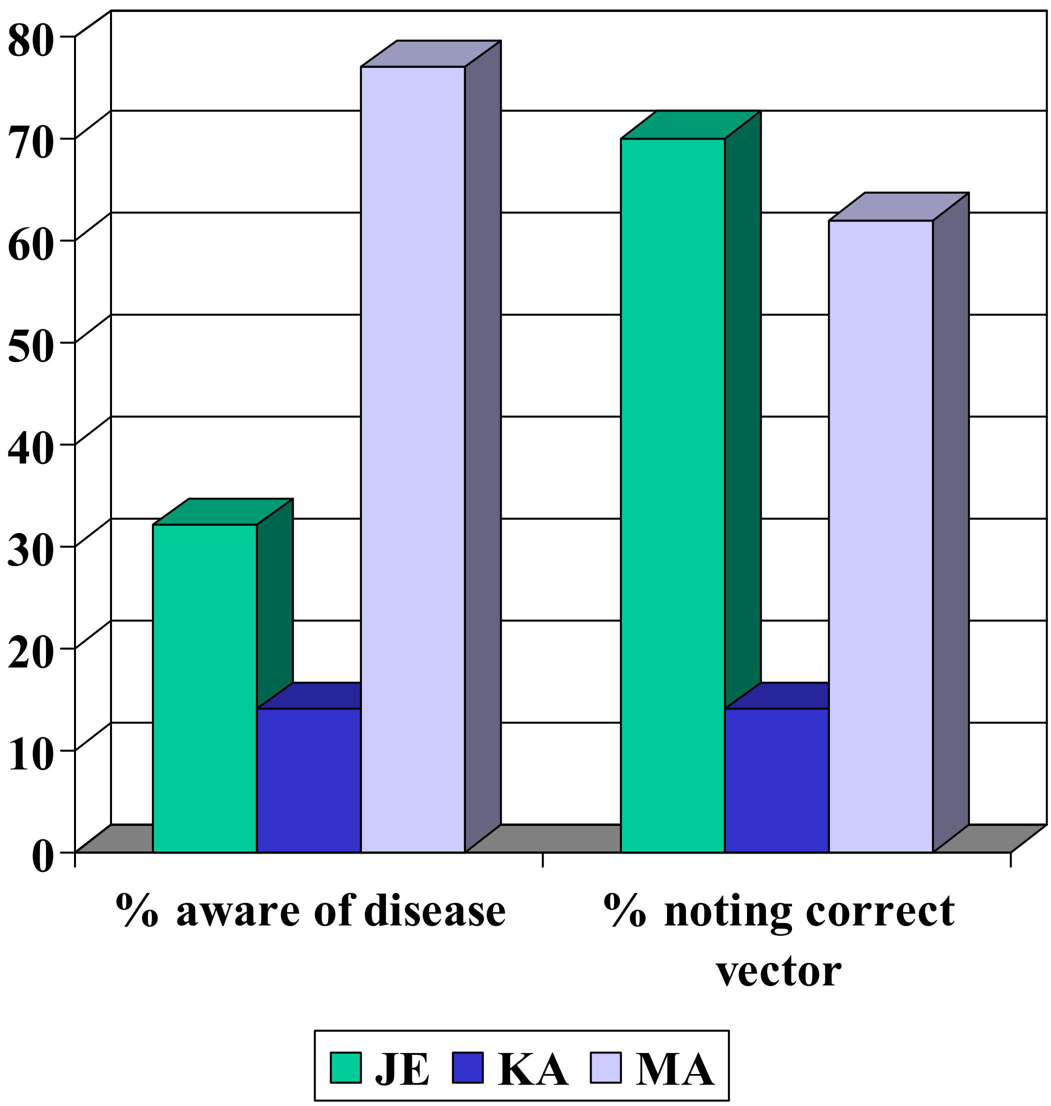
Variation by Ecoregion



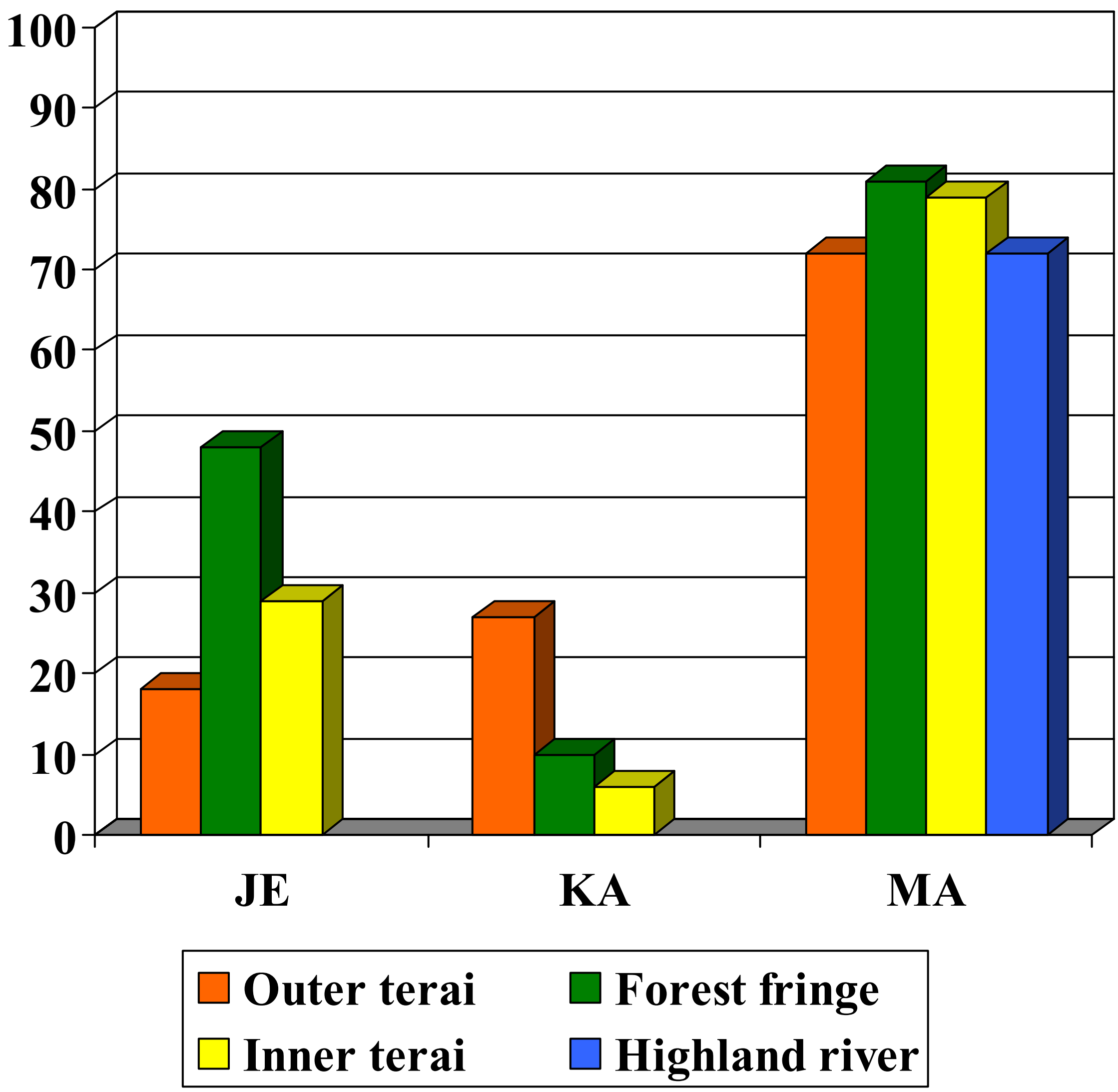
Variation by Ethnicity



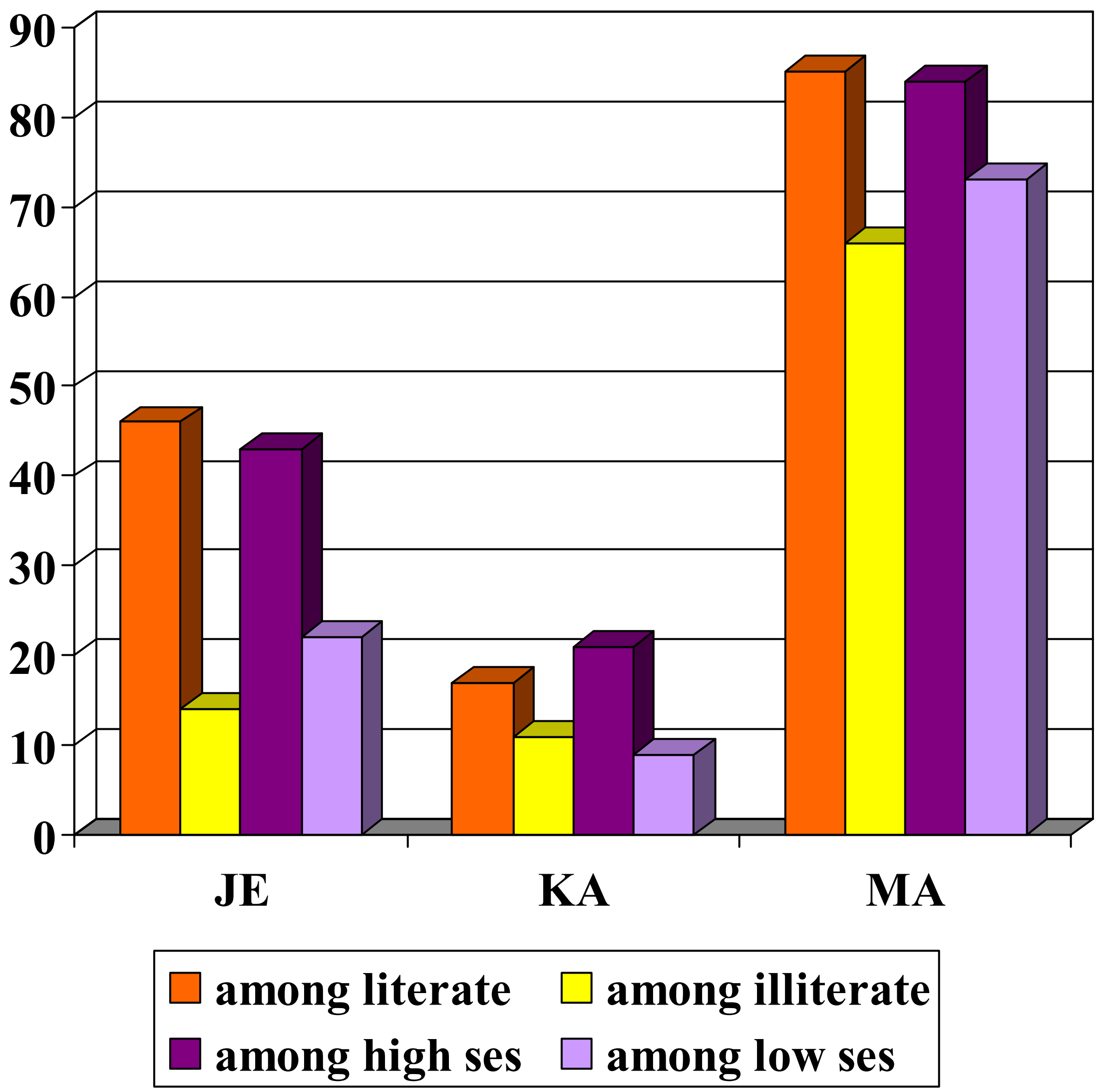
General Disease Awareness



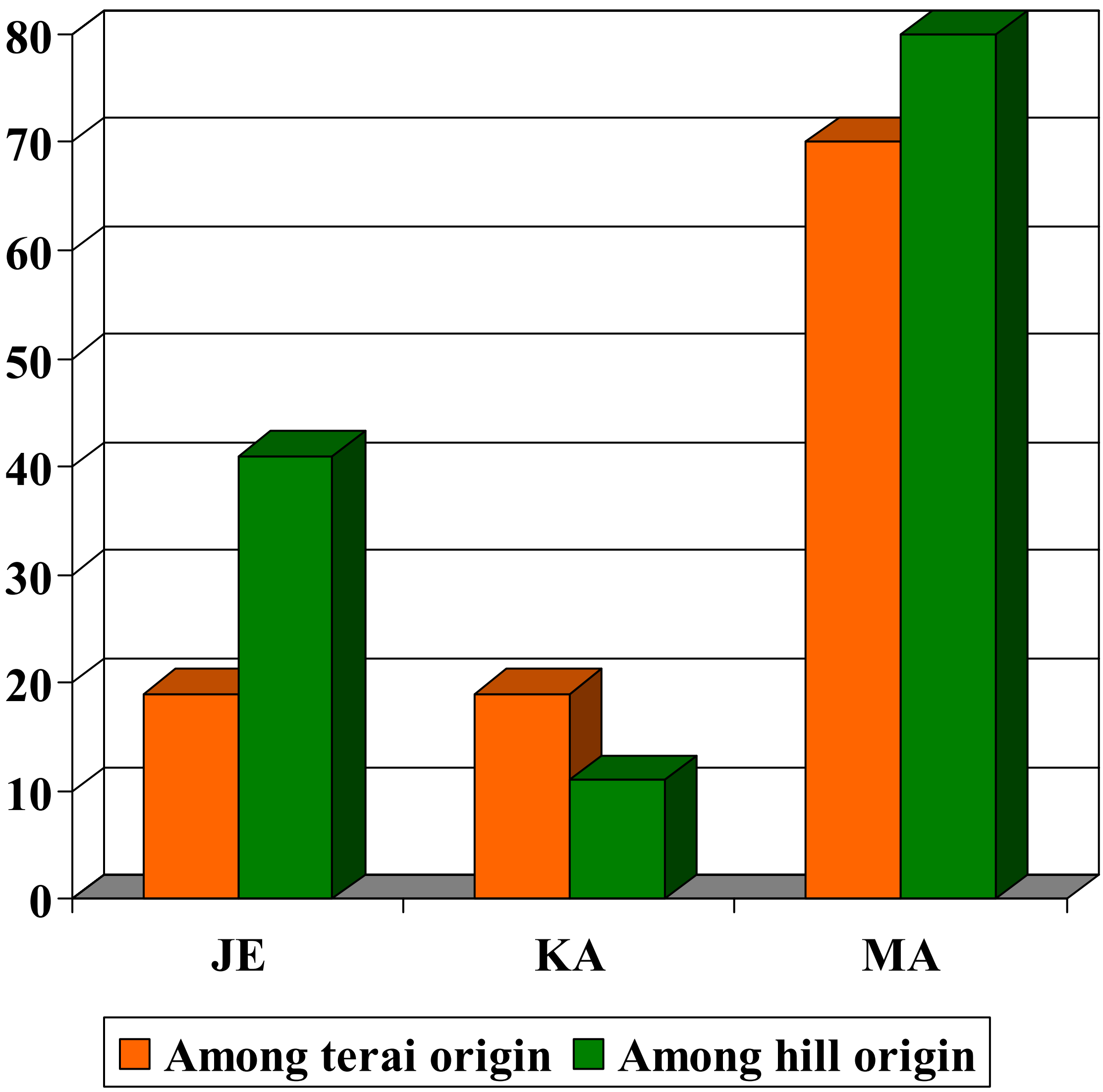
Variation in Awareness by Ecoregion



Variation in Awareness by Literacy and SES



Variation in Awareness by Ethnicity



Implications for general awareness interventions

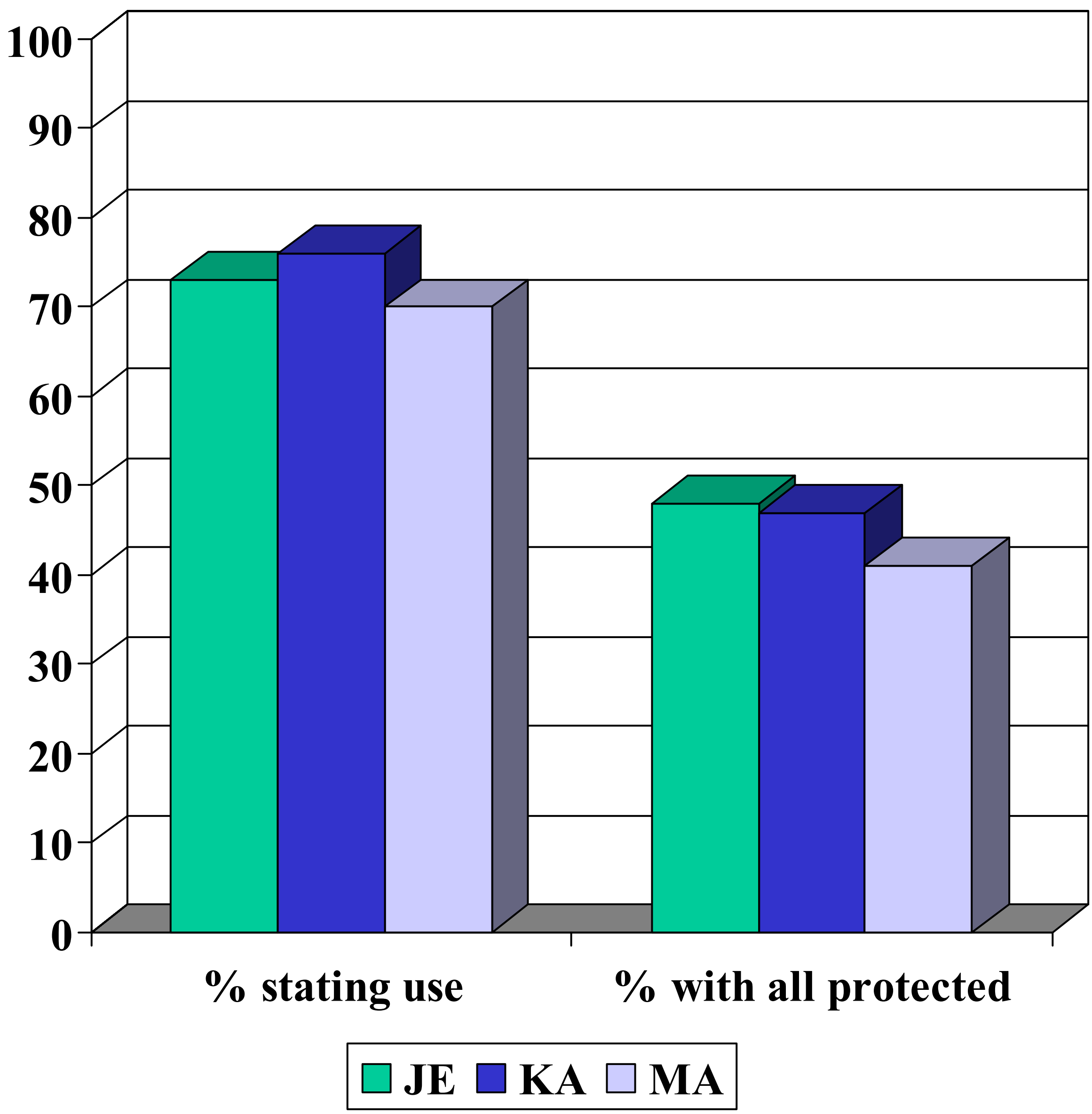
Disease awareness can improve, and is likely to improve understanding for both JE and KA

Awareness is higher in the forest fringe for JE, and in the outer terai for KA, suggesting that awareness signifies more familiarity with the disease in these areas

Increasing awareness is associated with reduced risk behaviors

For KA there was poor understanding of the disease even among those aware

Bed Net Use



100
90
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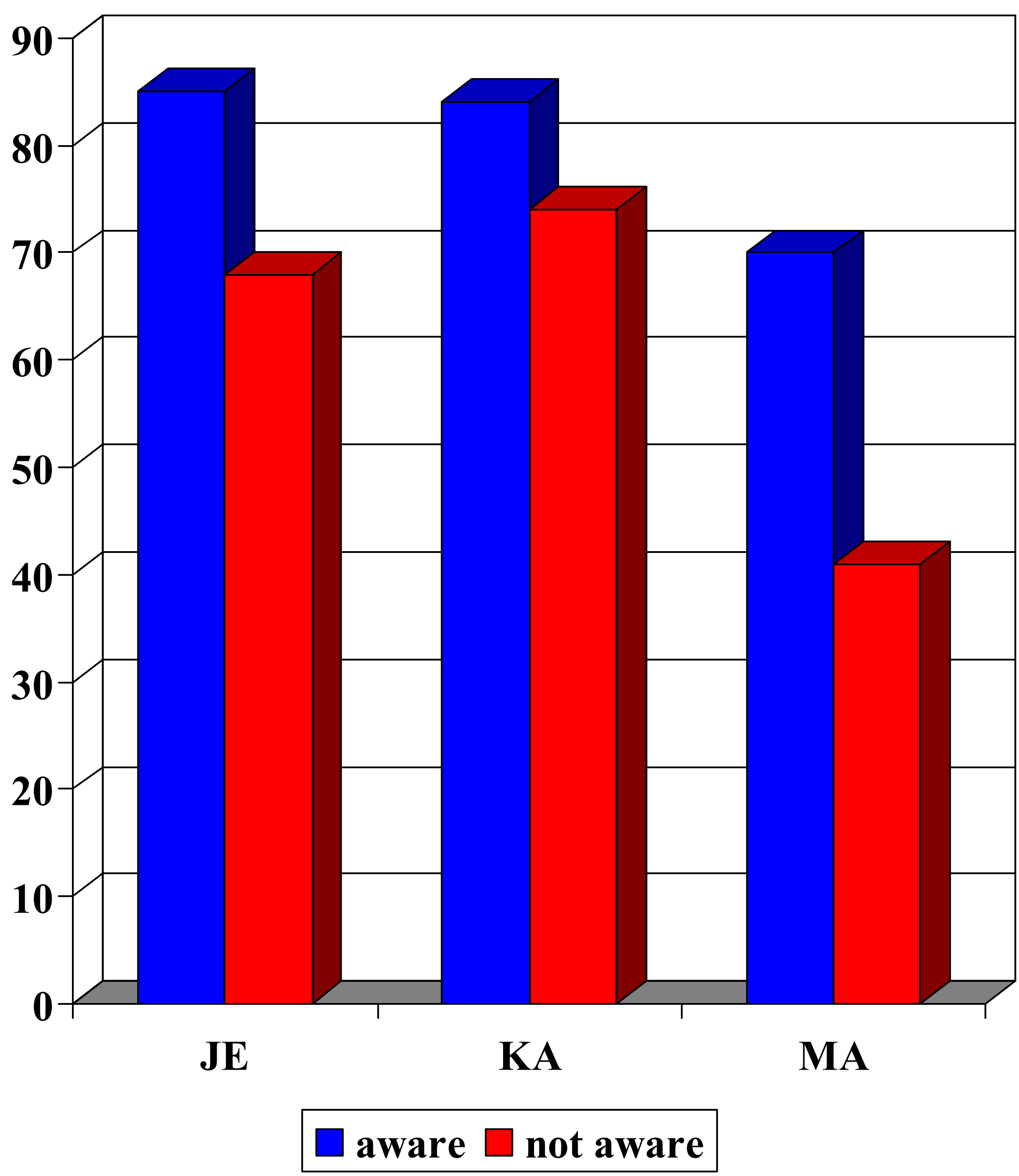
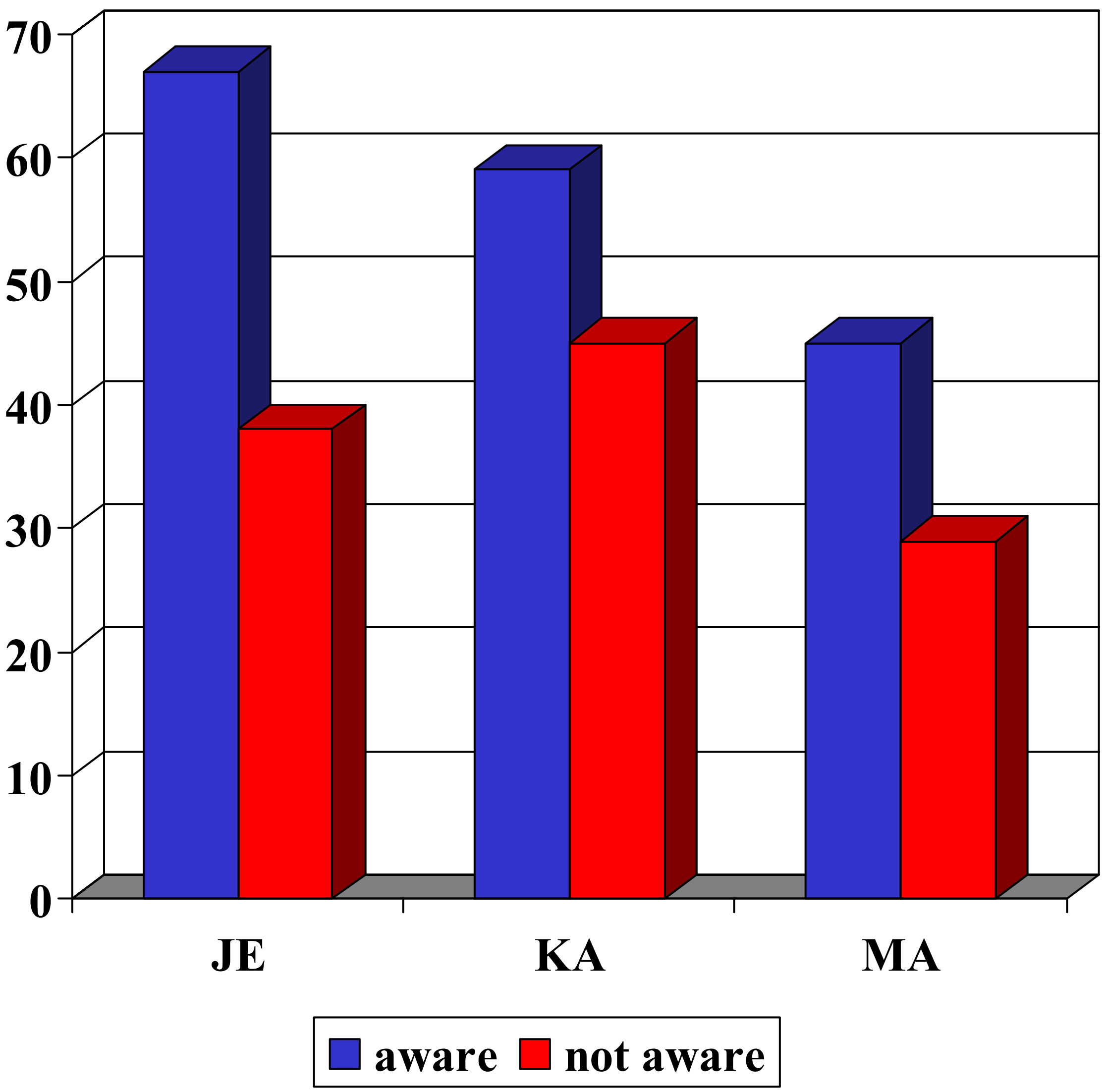
Influence of Disease Awareness on Bed Net Use



Influence of Disease Awareness on Having All Members Protected



Behaviors of interest for JE				
	Total	By Ecoregion		
		Outer Terai	Forest Fringe	Inner Terai
% knowing of vaccine (n=569)	**14%**	19%	10%	19%
% with any family member vaccinated (n=1800)	**1%**	0%	0%	1%
% owning pigs (n=1800)	**9%**	1%	18%	8%

Behaviors related to Kala Azar				
	Total	By Ecoregion		
		Outer Terai	Forest Fringe	Inner Terai
% sleeping only on floor (n=1800)	**11%**	13%	4%	16%
% sleeping on ground floor (n=1800)	**59%**	82%	52%	42%
% w/ family case (n=1800)	**1%**	2%	1%	0%

Implications for behavior change interventions

High bed net use but high % with some unprotected

High % with KA breeding sites and risk sleeping behavior, but not clustered with disease awareness

High awareness of pig association for JE, but very little awareness of vaccination

Disease awareness reduced most risk factors except for KA

Data Related to Environmental Interventions

Less than 5% said their house was sprayed

Most felt cleaning the environment would reduce risk

Most felt it was the government's responsibility to control VBDs

Most felt the community should do more to clean the environment, but few understood breeding sites

Data Related to Health Infrastructure

Most mentioned health facilities as sources of care, but less than 20% had confidence in the services provided

Understanding of signs and symptoms was highest for MA, and low for JE and KA

Stated care-seeking was at health facilities, but actual practice may differ