A Study on Risk Factors Associated with Japanese Encephalitis in Selected Districts of Western Nepal

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Abstract

Introduction	Japanese encephalitis is a fatal disease of great public health importance highly prevalent in Banke, Bardiya and Dang district, the terai districts of mid-western region. Bheri zonal Hospital reported highest number of cases during 1993-1997 period constituting the total cases 2087 and total deaths 394 with case fatality rate of 18.9 percent. Keeping in view of highest incidence in Banke, Bardiya and Dang districts, a study was carried out on risk factors of Japanese Encephalitis.
Objectives	The general objective of the study was to study the occurrence of Japanese Encephalitis in a high-risk population.
Method	The design was case-control study. The technique for study was retrospective and quantitative. The subjects were selected by record review in hospitals and community search. The interviews and observations were data collection methods. The questionnaire and observational checklists were tools for data collection. Total of 142 numbers of confirmed Japanese Encephalitis cases and 142 controls from Banke, Bardiya and Dang districts were interviewed.
Results	The study revealed that 96.5 percent cases and 83.8 percent controls were un-immunized against Japanese encephalitis and odds ratio 5.30, which shows remarkable difference in exposure rate. The study showed that presence of household pig among cases and controls was 45.1 percent and 35.2 percent respectively with odds ratio 1.51. The study revealed that use of mosquito net was low. Only 39.4 percent of cases used mosquito- net in comparison to 63.4 percent mosquito-net users in controls with odds ratio 2.66 showing remarkable difference. The study showed that 38.7 percent were outdoor sleepers in cases and 23.2 percent in controls with odds ratio 2.09 showing remarkable difference in two groups. It is concluded that non-immunization status, presence of household pigs, non-use of mosquito net and sleeping out door are the risk factors related with the occurrence of Japanese Encephalitis.
Conclusions	It is concluded that non-immunization health status, non-use of mosquito net, presence of household pig and sleeping out door are the main risk factors related with occurrence of JE. The non-immunized subjects are at greater risk of developing JE in comparison to immunized subjects. Mosquito net non-users are at increased risk of developing JE in comparison to mosquito net users. Out door sleepers are at increased the risk of acquiring JE in comparison to indoor sleepers.
Key words	Immunization status, Household pigs, Use of mosquito net, Sleeping place

Introduction

Japanese encephalitis (JE) is a fatal disease caused by a group B arbovirus (flavivirus) through bote of mosquitoes. It is primarily a zoonotic disease infecting mainly animals and man is involved as an accidental host and plays no role perpetuating the virus (Pavri, 1979).

Approximately 50,000 cases and 10,000 deaths are estimated to have occurred every year in the Asian continent (Bunce et. al., 1998, dominant com. Dis, WHO, 1997). The clinical disease of JE in man occurs in an approximately one on every 20 to 1000 infections with the mean of one case for every 300 infections (Kalyanarooj, S., 1995).[2,6]

In the South East Asia Region (SEAR), JE is prevalent in Northern Thailand, as well as in Bihar, Uttar Pradesh, Tamil Nadu and West Bengal states in India, in the Terai areas of Nepal and in Sri Lanka. Cases have been reported in Bangladesh, Indonesia and Myanmar as well (Dom. Com Dis, WHO, SEARO, 1997).

Thirty species of mosquitoes belonging to five genera of *Culex, Anopheles, Aedes, Mansonia and Amergers* harbor the viruses of JE. Since *Cx tritaneorhynchus* is found in abundance in the rice field ecosystem of the endemic areas during the transmission season and because JE virus isolates have been obtained only from a pool of *CX tritaneorhynchus* female species, this species is suspected to be the principal vector in Nepal (Gubler et. al. 1989, Darsie et. al. 1989).

Pigs are important amplifying host of JE virus. Infected pigs generally do not manifest overt symptoms of illness. Virus of JE proliferates in pigs, which remain viremic for several days so that the biting mosquitoes become infected. Since pigs become infected as a result of the bite of an infected mosquito and can transmit the virus to many others, they are called amplifiers of virus transmission.

JE Virus is one of the species of the family flaviviridae. It is an enveloped RNA Virus and is antigenically related to St. Louis encephalitis (SLE) Virus, Rocio Virus, West Nile Virus and several other flaviviruses (Gubler, 1989).[4,6] Up to now prevalence of three different strains of JE virus (JEV) have been reported in Nepal (Nep 1190, B-2524 and B-9548).

JE is a big health problem in Nepal as its incidence is in increasing trend. Geographically, terai districts of Nepal are affected from JE. Banke, Bardiya, Dang and Kailali are the districts severely affected with high incidence of JE each year.

A large number of JE cases were reported from Banke, Bardiya and Kailali districts. Druing 1993 - 1997, more than 66% cases and 67% deaths out of total national JE cases were reported from the above three districts. Majorities of the JE cases were being reported from Bheri Zonal hospital (Banke) and Seti Zonal Hospital (Kailali). Bheri Zonal Hospital of Nepalgunj (Banke) reported highest number of cases during 1993 - 1997 period constituting the total cases 2087 and total deaths 394, with CFR of 18.9%[1,2,3,4,7]

Since 1978, the division of epidemiology has been reporting on an average about 500 to 700 cases per year with the case rate of 2 to 7 per 100,000 population per year with average case rate of 3.26 per 100,000 population per year.[1]

During the year 1993-1997, twenty four districts of terai region from Jhapa in the east and Kanchanpur in the far west were affected from JE. During the year 1999, two districts, Banke and Kailali reported 71% of the total number of cases.[4]

The general objective of this study is to study the occurrence of Japanese Encephalitis in high-risk population of the three aforementioned districts.

The specific objectives of this study are to determine the immunization status and its relationship with occurrence of Japanese encephalitis, to determine relationship between presence of household pigs/ ducks/ other animals and occurrence of Japanese Encephalitis, to determine relationship between use of mosquito net and occurrence of Japanese, to determine the relationship between sleeping place and occurrence of Japanese Encephalitis.

Thus as hypothesis it can be stated that the frequency of JE infection is higher in un-immunized subjects than immunized subjects. Moreover it can be supposed that the frequency of JE infection is higher in subjects having household pigs/ ducks than those who do not have. Similarly it is assumed to be that frequency of JE infection is higher in mosquito net non-users than mosquito net users and the frequency of JE infection is higher among out door sleepers than indoor sleepers.

Methodology

It was a case control study. Banke, Bardiya and Dang districts were the study area. Methods of subject selection for the study were:

- Record review for selection of cases: For case selection the record of patient admitted during the year 2001 diagnosed clinically as JE with positive serological lab test were reviewed from two hospitals of Banke district and one hospital of Bardiya district.

Community search for selection of control: For comparison controls were selected from the same community were the cases located.

The data were collected by interviewing the subjects with questionnaire and observations with checklists. The independent variables are *immunization status, presence of household pigs/ ducks/ other animals, use of mosquito net, sleeping place* and the dependent variable is *occurrence of JE.*

Criteria: Confirmed cases i. e. those cases having clinical signs and symptoms of JE and positive specific anti JE-IgM were included as case in the study. Controls selected were those having no history of clinical signs and symptoms of JE from the same community were the cases lived having same characteristics as case in term of age, sex, and ethnic group. Sampling technique for this study was purposive sampling. All the JE cases with positive serological ELISA test admitted in three hospitals: Bheri Zonal Hospital, Nepalgunj hospital and Bardiya Hospital was the Sampling population. There were 142 confirmed JE cases and 142 controls with case control ratio of 1:1. Data collection was started on 1st Paush, 2058 and completed on 15th Magh, 2058. Data was processed and analyzed using computer EPI Info 6.04 version program.

Limitations of Study

➤ Serological lab investigation was not performed in selection of controls from the community. Selection of control was based on history only without performing serological lab test which may not rule out sub clinical JE infection.

➤ Selection of controls in the same village as of cases may not give real estimation of risk factor related with JE.

Results

3.1 Socio-Demographic Characteristics of the Study Subjects

Table I. Socio-Demographic Profile of the Study Subjects

Age Group	Case		Control	
	No.	%	No.	%
0-4 years	16	11.3	16	11.3
5-9 years	36	25.4	36	25.4
10-14 years	24	16.9	24	16.9
15-19 years	9	6.3	9	6.3
20-24 years	13	9.2	13	9.2
25-29 years	11	7.7	11	7.7
30-34 years	7	4.9	7	4.9
35-39 years	5	3.5	5	3.5

40 years +	21	14.8	21	14.8
Total	142	100.0	142	100.0
Sex				
Male	76	53.5	76	53.5
Female	66	46.5	66	46.5
Total	142	100.0	142	100.0
Religion				
Hindu	141	99.3	141	99.3
Muslim	1	0.7	1	0.7
Total	142	100.0	142	100.0
Ethnic Group				
Brahmin/ Chhetri	23	16.2	23	16.2
Magar	18	12.7	18	12.7
Tharu	79	55.6	79	55.6
Damai/ Kami	10	7.0	10	7.0
Others	12	8.5	12	8.5
Total	142	100.0	142	100.0

Table I shows that 5-9 age group has highest number which comprise of 25.4 percent of the total sample population. The second largest age group is 10-14 age group, which comprise of 16.9 percent of total sample population. There were 53.5 percent male and 46.5 percent female in the study population in each group. Majorities of study subjects were of Hindu religion. Majorities of cases were of Tharu ethnic group comprising of 55.6 percent in both case and control group.

3.2 Relationship between Immunization Status and Occurrence of JE

Table II. Immunization Status of JE Case and Control

Immunization Status	Case		Control		Odds Ratio	P Value
	No.	%	No.	%		
Non-Vaccinated	137	96.5	119	83.8	5.30	0.0007
Vaccinated	5	3.5	23	16.2		
Total	142	100	142	100		

Table II shows that the immunization coverage was very low. Only 3.5 percent of cases and 16.2 percent of subject controls were immunized with JE vaccine, which shows remarkable difference in the immunization status. The study has shown that un-immunized subjects are at 5.3 times increased risk of developing JE in comparison to immunized subjects.

Table III. Presence of Household Pigs in JE Case and Control

House hold Pig	Case		Control'		Odds Ratio	P Value
	No.	%	No.	%		
Yes	64	45.1	50	35.2	1.51	0.11
No	78	54.9	92	64.8		
Total	142	100	142	100		

Table III shows that presence of household pig among cases and controls was found to be 45.1 percent and 35.2 percent respectively. The study has shown that those subjects having household pigs are at 1.51 times higher risk of acquiring JE infection in comparison to subjects not having household pigs. However, P value 0.11 shows the insignificant difference in case and control in term of presence of household pigs in occurrence of JE.

3.4 Relationship between use of Mosquito-net and Occurrence of JE

Table IV. Status of use of Mosquito Net in JE Case and Control

Use of Mosquito-Net	Case		Control		Odds Ratio	P Value
	No.	%	No.	%		
Yes	86	60.6	52	36.6	2.66	0.00008
No	56	39.4	90	63.4		
Total	142	100	142	100		

Table IV shows 60.6 percent of cases and 36.6 percent of controls were mosquito-net non-users, which indicates remarkable difference. The study showed that mosquito net non-users are at 2.6 time's greater risk of developing JE in comparison to mosquito-net users.

3.5 Relationship between Sleeping Place and Occurrence of JE

Table V. Sleeping Place of JE Case and Control

Sleeping Place	Case		Control		Odds Ratio	P Value
	No.	%	No.	%		
Out-Door	55	38.7	33	23.2	2.09	0.007
In-Door	87	61.3	109	76.8		
Total	142	100	142	100		

Table V shows that outdoor sleepers were 38.7 percent in cases and 23.2 percent in controls. The study has shown that outdoor sleepers are at 2.09 times' greater risk of developing JE infection in comparison to indoor sleepers.

Discussions

This study showed that average Vaccine effectiveness with both inactivated/ live attenuated JE vaccine was 82.1 percent. The finding of vaccine effectiveness is consistent with previous study findings as mentioned below: The effectiveness of live attenuated JE vaccine SA 14-14.2 was 90% (as 95% CI 44 to 93%); that of two doses was 97.5% (Hennessy S. Zhengle L. *et al.*). [11]

This study has revealed that non-vaccinated subjects are at 5.3 times increased risk of developing JE in comparison to vaccinated subjects which is similar with the study findings as mentioned below:

An un-immunized child was at 4.54 times greater risk of developing JE than a fully immunized child (Dapeng L. Konghua Z. *et a.l*) [14]

The study shows that non-immunization status is a risk factor for occurrence of JE.

Thus, the hypothesis that the frequency of JE infection is higher in un-immunized subject than immunized subject has been supported by this study.

The study revealed difference between cases and controls in term of presence of household pigs and occurrence of JE. There were more subjects having house hold pigs in cases in comparison to controls. The study showed that subjects having house hold pigs are at 1.51 times greater risk of developing JE in comparison to subjects not having household pigs, however pig value is not significant.

The hypothesis that frequency of JE infection is higher in subjects having pigs in house than those who do not have has been supported by this study.

There were more mosquito-net nonusers in cases in comparison to controls. The data of the study showed that mosquito-net non-users are at 2.6 time's greater risk of developing JE in comparison to mosquito-net users. The study has identified non-use of mosquito net as a risk factor for occurrence of JE.

Thus the hypothesis that the frequency of JE infection is higher among mosquito net non-users than mosquito net users has been supported by this study.

It is found from the study that there were more outdoor sleepers in cases in comparison to controls. The data showed that outdoor sleepers are at 2.09 times' greater risk of developing JE in comparison to indoor sleepers.

Thus the hypothesis that the frequency of JE infection is higher among outdoor sleepers than indoor sleepers has supported by the study.

Conclusion

It is concluded that non-immunization health status, non-use of mosquito net, presence of household pig and sleeping out door are the main risk factors related with occurrence of JE. The non-immunized subjects are at greater risk of developing JE in comparison to immunized subjects. Mosquito net non-users are at increased risk of developing JE in comparison to mosquito net users. Out door sleepers are at increased the

risk of acquiring JE in comparison to indoor sleepers. The study showed that subjects having house hold pig are at increased risk of developing JE in comparison to subjects not having household pig.

Recommendations

1. JE immunization should be implemented in Banke, Bardiya and Dang district aiming to achieve high immunization coverage focusing on the high-risk area where higher numbers of JE cases are seen.

2. Health education campaign should be conducted to increase awareness among community people at VDC level for control and prevention of JE.

3. Reduction of vector contact is most feasible countermeasure. Community people should well motivated to use mosquito net to protect from mosquito bites.

4. People should be discouraged to sleep outside the house during summer as it increases the risk of acquiring JE infection. Community people should be advised to remain body part unexposed by wearing clothes in order to prevent mosquito bites.

5. Pig shed should have door/window wire screen and there should be restriction on free movement of pigs to be controlled by local authority.

References

1. Bista MB, Shrestha K and Devkota UN. *Gastroenteritis, Encephalitis, Meningitis & Kala-azar:* An epidemiological review publication from epidemiology division, Ministry of Health. March, 1993

2. Bista MB, Bastola SP, Shrestha S et. al. *Japanese encephalitis (1993- 19970), epidemiological analysis and review of literature.* Feb., 1999.

3. Bista MB, Banerjee MK. *Arboviral encephalitis including Japanese encephalitis and other flavi viruses, Analysis of 1999 Data and Review of Literature.* April 200

4. Bista MB. *Japanese encephalitis in Nepal-2000, analysis of 2000 data and review of literature.* January, 2001.

5. Parajuli MB, Joshi DD, Pradhan SP, Chamling M and Joshi AB. *Incidence of Japanese encephalitis during 1989 in Nepal.* Journal of Nepal Medical Association, 1992; 30:7-14

6. *CDC MMWR recommendations and reports,* Inactivated Japanese encephalitis Virus Vaccine Recommendations of the Advisory Committee on Immunization Practices (ACIP) web pages.

7. Joshi DD. *Epidemiological profile of Japanese encephalitis in Nepal (1996/1997).* Journal of Nepal Medical Association 2000, 22: 23-31

8. Park JE, Park K. *Text book of preventive and social medicine.* 16th ed. Nov, 2000: 215-216

9. Chia-Chi K, Chwan-Chuen K et. al. *Homologous and heterologous neutralization antibody responses after immunization with Japanese encephalitis vaccine among Taiwan children.* Journal of Medical Virology, 1994; 44: 122-131

10. Dapeng L, Konghua Z, Jinduo S et. al. *The protective effect of bed nets Impregnated with pyrethroid insecticide and vaccination against Japanese encephalitis.* Transactions of the royal society of tropical medicine and hygiene, 1994; 88: 632-634.

11. Hennessy S, Zhengle L, Tsai T F et. al. *Effectiveness of live-attenuated Japanese encephalitis vaccine (SA 14-14-2):* a case control study.

    The Lancet. June, 1996; 347: 1583-1586

12. Ogawa S, Shrestha M P, Rai SK et. al. *Serological and virological studies of Japanese encephalitis in the terai region of Nepal.* South-east Asian. Trop. Med. Public Health. March, 1992; 23: 37-43

13. Risbud AR, Sharma V, Rao M et. al. *Post-epidemic serological survey for JE virus antibodies in south Arcot district (Tamil Nadu).* Indian J. Med. Res., Jan 1991; 93: 1-5

14. Dapeng L, Huijun Y, Liau X and Ze W. *The efficacy of Japanese encephalitis vaccine in Henan, China:* a case-control study. December, 1994; 25(4): 643-646

15. Sakai T, Horimoto M, and Goto H. *Status of Japanese encephalitis infection in cattle: survey of antibodies in various geographical locations in Japan.* Jpn. J. vet. Sci., 1085; 47(6); 957-963

16. Plesner A, Arlien-Sborg p, Herning M. *Neurological complications and Japanese encephalitis vaccination.* 1996; 348: 202-203.